ELECTRONICS Australia

with CB and HIFI NEWS

MARCH, 1977 AUST $1.00* NZ $1.20

THE POSITIVE SIDE OF NUCLEAR POWER

NEW FREQUENCY METER * BABY COMPUTER

TESTING AIWA MICROPHONES

Now from Sony: the Definitive Direct Drives.

No one knows better than Sony how clearly superior the servo motor direct drive system is in turntable design — after all, we started it all more than ten years ago with the revolutionary TTS 3000. All the vast experience we've gained in producing direct drives in the decade since plus some remarkable new developments, are incorporated in this outstanding new range for 1977.

Turntables

PS8750 Photo-Electric, Direct Drive Turntable

Sony's finest turntable, ever. This is the ultimate precision instrument for reproducing sound from today's wide dynamic range recordings. Incorporates a great number of operating features developed exclusively by Sony. The performance is incredible with wow and flutter 0.025% (WRMS). Speed deviation within 0.003% , Signal/noise 70dB (DIN-B).

Features:

• Crystal-control, "X-tal Lock", system governs speed with superb accuracy compensating automatically for any variation in load/speed factors. • "Magnedisc-servo" system using magnetic auto monitor for precise speed, irrespective of voltage variations. • Direct drive servo motor provides exceptionally stable and accurate performance. • Photo-electric sensor for disc-end has no impact on cartridge or disc. • Feather-touch switch for stop/start and reject. • Entirely new moulding material SBMC minimises cabinet resonance. • Arm pipe and shell made of carbon fibre suppresses resonant feedback. • Dual supported jewel pivot. • Static insulated dust cover allows use of extremely light cartridges. • Oil-filled rubber damping mat absorbs disc vibration. • Remote viscous-damped cueing. • Tone-arm height adjustment for various cartridges.

PS4300 Photo-Electric Fully automatic Direct Drive Turntable

This is the feature-packed direct drive that audio experts have been waiting for. Total control convenience is achieved without compromise in performance. Wow and flutter a virtually unmeasurable 0.03% WRMS and Signal/noise 70dB (DIN-B).

Features:

• "Magnedisc-Servo" control automatically monitors and electronically compensates for voltage variations, giving precise speed. • Brushless and slotless direct drive motor for great accuracy of speed. • Fully automatic system for start, stop, cut and repeat. • Photo-electric sensor for disc-end eliminates mechanical impact. • Auto lowering in manual operation. • Plinth made of accoustically "dead" SBMC material eliminates feedback. • Highly sensitive tone-arm and Sony high performance cartridge XL-15 included. • Anti-skating device and lateral balancer. • Feather-touch controls.

PS3300 Automatic Direct Drive Turntable

Now you can obtain the superior performance of direct drive at the price of a belt-drive! And the performance is astonishingly good with wow and flutter only 0.04% WRMS and Signal to noise 65dB (DIN-B). Aesthetically, the PS3300 is most appealing with a slim and ultra-modern appearance that will enhance any HI-Fi System.

Features:

• Brushless and slotless direct drive motor for precise, even speed. • DC-servo control monitors and electronically compensates for any spurious influences on speed. • Automatic system for arm return. Cut and repeat. • Illuminated stroboscope and electronic pitch control adjustments. • Viscous damped cueing system for protection of cartridges and disc. • Highly sensitive "S" tone arm and Sony's magnetic cartridge VL-32G included. • Anti-skate device and lateral balancer.

SONY®

Research makes the difference.

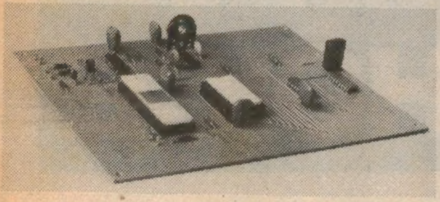
GAC.S.7902

ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 38 No 12

This is our latest digital frequency meter. The new design features a 7-digit readout, employs just 12 integrated circuits, and can measure up to 200MHz. The constructional details start on p30.



Costing around $70 to build, this microcomputer system will provide enthusiasts with a simple, low-cost way of getting to know the Signetics 2650 microprocessor. It offers the same debug and monitor program in ROM provided by more expensive systems, together with 256 words of RAM. Details on p68.

RTTY demodulator: on page 46 this month we describe a simple RTTY demodulator which, when interfaced between a communications receiver and a surplus Baudot teleprinter, will enable you to receive amateur and commercial teletype transmissions. It's easy to build too, all on a single PC board.

On the cover

The performance and reputation of AIWA microphones has resulted in their use by many professional recording studios. The cover shows AIWA microphones undergoing anechoic chamber testing as part of a rigid quality control program. (Picture courtesy AIWA Australia Pty Ltd, 14 Gertrude St, Arncliffe, NSW 2205.)

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regular features

CATALOG NEXT MONTH

Next month's issue will contain a 24-page catalog from Davred Electronics Pty Ltd. This company has just commenced operations in Australia, and is offering a wide range of equipment and electronic components. For a brief resume, turn to page 27.

Editorial Viewpoint

CB: A decision needed urgently

As I sit down to write this leader, it is only a few days since the Minister for Posts and Telecommunications released the discussion paper prepared by his department on CB radio (see our news item on page 29). Predictably, the paper has generated renewed interest in and discussion of the whole CB question.

While the somewhat insular bureaucratic origin of the paper is apparent both in the terminology used and in the assumptions made in certain places, its appraisal of the various and often conflicting considerations with regard to legalisation of an Australian CB service is fairly even-handed. So much so that many have already criticised the paper for its failure to give concrete recommendations.

As for the paper's three suggested options, none would seem to be without its problems. The main problem for these or any proposed form of CB service is the provision of adequate controls; controls not only of the equipment used, but of the way it is used. The controls must be sufficient to ensure a reasonable standard of service for the majority of users, but at the same time they must be realistic—in other words, they must be capable of being enforced at reasonable cost.

Inevitably, any proposed plan must take into account the already large and growing number of illegal operators currently using 27MHz US-style CB equipment. This being the case, the paper's third option just doesn't seem realistic. And as both of the other options seem to have inadequacies, perhaps the best plan would be to effectively combine the two: provide for a variety of services on the 27MHz band using basically the same equipment, but restrict "personal" and "hobby" activity to a limited number of channels. Radio amateurs, volunteer services and others would use different channels, but with one or more channels set aside for emergency communications by ALL users.

Whether this sort of plan is adopted or not, however, there is one thing certain: action should be taken as soon as possible. Already the situation has been allowed to develop beyond the point where all options are equally viable; a UHF service is really no longer feasible, for example,—at least in the short term.

The longer a decision is delayed, the fewer the options which will be left. In fact if it is delayed much longer, the only real option will be simply to legalise a full-scale US-style CB service—because we will already have one.

One final point. Many of the imported CB transceivers currently being sold and used have public-address or "PA" facilities. These may be worthwhile in marine situations, but they are too easily abused on the road. In our opinion, the use of such facilities should be banned by the traffic authorities—in the interests of road safety.

—Jamieson Rowe

EDITOR-IN-CHIEF
Neville Williams
M.I.R.E.E. (Aust.) (VK2XV)

EDITOR
Jamieson Rowe
B.A. (Sydney), B.Sc. (Technology, NSW)
M.I.R.E.E. (Aust.) (VK2ZLO/T)

ASSISTANT EDITOR
Philip Watson
A.M.I.R.E.E. (Aust.) (VK2ZPW)

SCIENCE FEATURES
Greg Swain, B.Sc. (Hons, Sydney)

PRODUCT REVIEWS
Leo Simpson

TECHNICAL PROJECTS
David Edwards, B.E. (Hons, Tasmania)
Ian Pogson (VK2AZN/T)

GRAPHICS
Robert Flynn

PRODUCTION
Daniel Hooper

ADVERTISING MANAGER
Selwyn Sayers

CIRCULATION MANAGER
Alan Parker

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Editorial Office
57-59 Regent St, Sydney 2008
Phone 699 3622.
Postal Address: PO Box 163, Beaconsfield 2014.

Advertising Offices
Sydney—57-59 Regent St, Sydney 2008. Phone: 699 3622.
Representative: Narcisco Pimentel.
Melbourne—392 Little Collins St, Melbourne 3000. Phone: 67 8131.
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Perth—454 Murray Street, Perth 6000.
Representative: Jack Hansen 21 8217.

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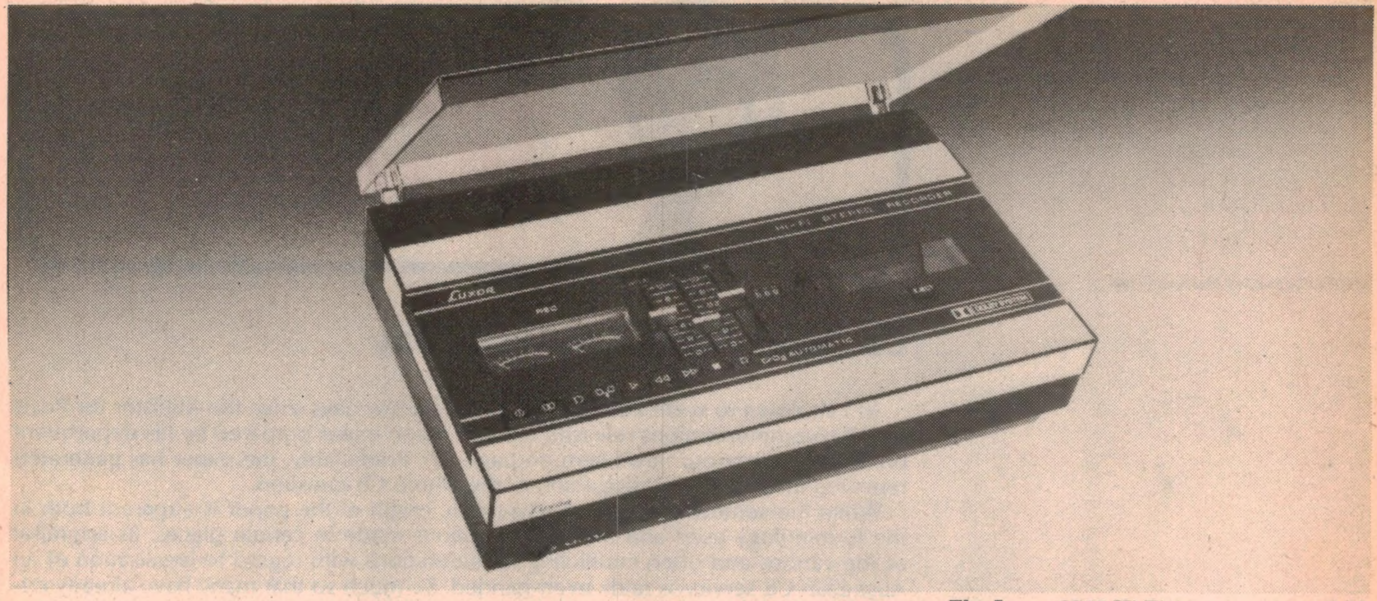


The Luxor 9255 Hi Fi stereo cassette deck

The Luxor 'Swedish Sound' Cassette Decks

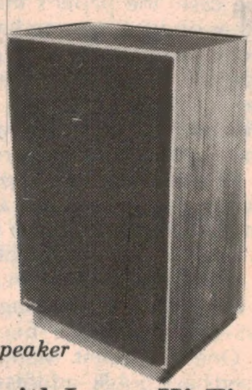
A superb cassette deck from Sweden's largest manufacturer of high-quality stereo systems

In 1923, at Motala in Sweden, Luxor first began serial production of radio sets. Since that time, Luxor has grown to be, among other things, Sweden's largest-selling range of high-fidelity stereo cassette decks.

Switch to the feature
The Luxor 9255 features a switch for the new ferro-chromium tapes, as well as automatic switching and adjustment to chromium-dioxide tapes. Headphone sockets for listening to both recording and playback. Separate inputs and switches for microphone and amplifier. Including mixing of the centre microphone with another sound source.

Technical features
The Luxor 9255 incorporates Dolby noise reduction and motors, with a tacho-controlled motor for constant speed. A tone head of 'super hard permalloy' for long life and better dynamics. Very low wow and flutter. And it is electronically controlled with automatic stop for all functions.

It looks as good as it sounds
Finished in an elegant black design with aluminium trimmings, and a plastic lid that will stay open in any position.



The Luxor Bass Reflex 50W loudspeaker

Combine with Luxor Hi-Fi Speakers. Luxor have a large range of speakers – from the 50W Bass Reflex with a 25cm bass unit, dome tweeter and treble unit. To a 15W speaker with a 13cm drive unit and a 6.5cm treble unit.

A Luxor record player

And Luxor record players
Luxor record players feature an exclusive system for mounting and balancing the pick-up arm. A magnetic dynamic cartridge with adjustable stylus pressure. And a 16-pole synchronous motor and belt drive.

The superb Swedish sound
As Sweden has developed in the world of music, so Luxor has developed in reproducing that sound. The more you know about Luxor speakers, the more impressive they become.

LUXOR
Sweden at its best.

To Luxor, P.O. Box 205,
Glen Iris, Victoria, 3146.

☐ I would like to know more about the Luxor range of stereo systems, including cassette decks.
☐ I am interested in becoming a Luxor distributor.
☐ I am interest in becoming a Luxor Stockist.

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Address ____________________
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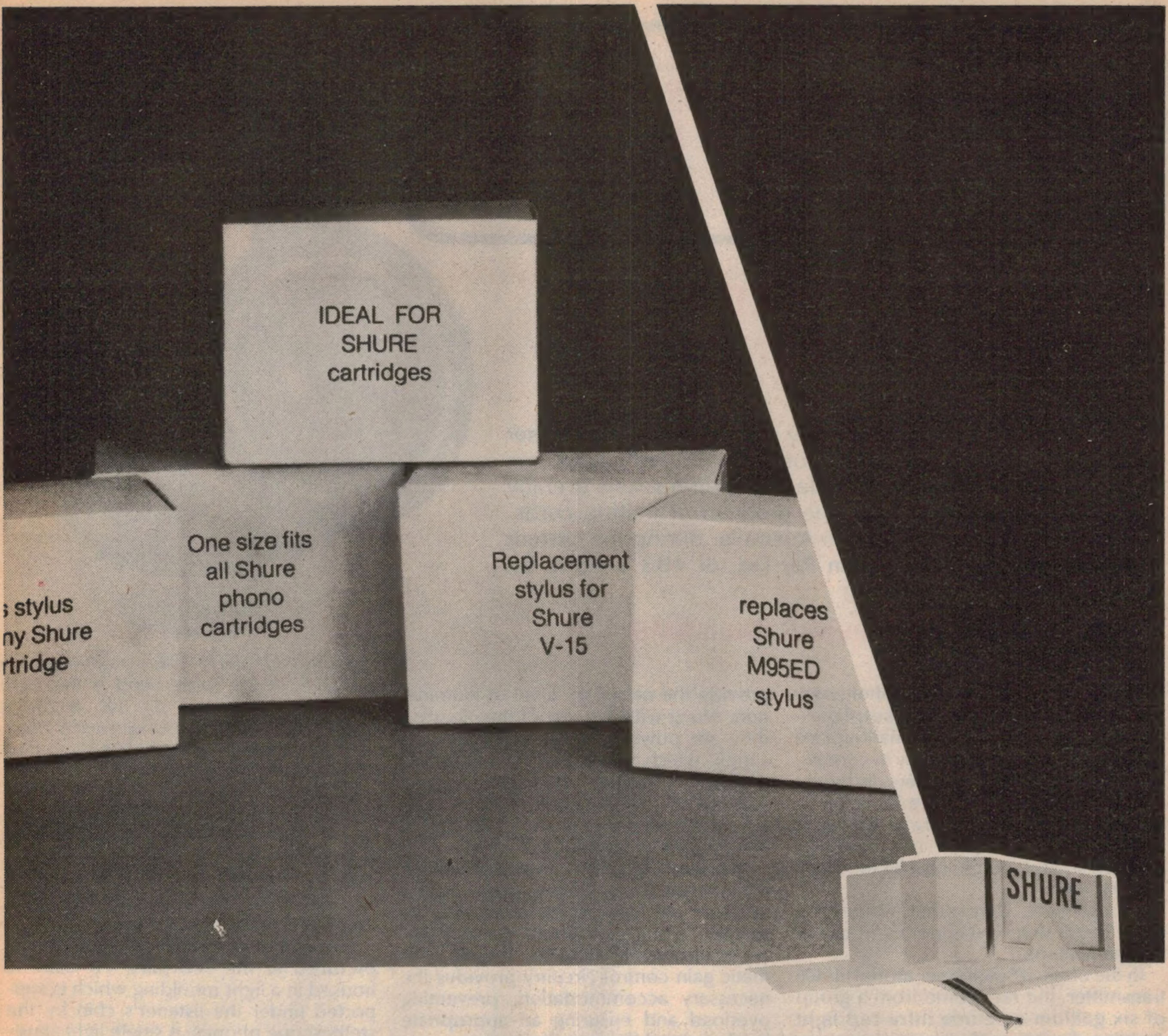
Postcode ____________

(Luxor, c/- 1396 Malvern Road, Tooronga, Vic.)

LUX146



Needle in the hi-fi haystack.

Even we were astounded at how difficult it is to find an <u>*adequate*</u> *other-brand replacement stylus for a Shure cartridge. We recently purchased 241 random styli that were not manufactured by Shure, but were being sold as replacements for our cartridges. Only ONE of these 241 styli could pass the same basic production line performance tests that ALL genuine Shure styli must pass. But don't simply accept what we say here. Send for the documented test results we've compiled for you in data booklet #AL548. Insist on a genuine Shure stylus so that your cartridge will retain its original performance capability–and at the same time protect your records.*

> *TECHNICORNER*
> *The criteria for these tests involved the eight standard production line inspections used for all Shure styli: Visual and mechanical inspection, tip configuration, trackability, vertical drift, 1,000 Hz output level measurement, channel separation at 1,000 Hz, channel separation at 10,000 Hz, and frequency response.*
> *Only genuine Shure styli have the name SHURE on the stylus grip and the words "This Stereo Dynetic® stylus is precision manufactured by Shure Brothers Inc." on the box.*

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Hi Fi News

CORDLESS INFRA-RED STEREO PHONES FROM SENNHEISER

Sennheiser's HDI-434 infra-red stereo phones. In the foreground is the right earpiece, containing the I.R. receiving diode, the left/right/stereo switch (top), off/on switch (bottom) and the two slide type volume controls.

As foreshadowed in our February 1976 issue, Sennheiser have announced a stereo version of their infra-red headphone system which will make it possible for hifi enthusiasts to enjoy headphone listening without the problem of trailing cords. The system is being released in Australia, during the current month, by R. H. Cunningham Pty Ltd, of 493 Victoria St, West Melbourne 3003.

by NEVILLE WILLIAMS

The infra-red cordless headphone system has been in the marketplace—particularly the European marketplace—for a couple of years, mainly in connection with television receivers. In some cases the facility has been built in; in others, an infra-red transmitter is installed on or under the receiver cabinet, so that the I.R. rays fill the likely viewing area.

According to Sennheiser, something like 100,000 units are currently in use in Germany alone.

In the original Sennheiser model SI-406 transmitter, the rays come from a group of six gallium-arsenide infra-red light emitting diodes, each mounted in a tiny reflector and operating in parallel to provide the necessary level of illumination. Along with the rest of the circuitry, they are powered from a small mains supply which plugs directly into a wall socket. The supply can be switched off and on as needed but, in any case, automatic circuitry turns the LEDs off in the absence of audio input signal.

Intended for mono only, this version can operate from an audio signal picked up from any convenient point in a TV receiver and at any amplitude level between about 10mV and 1V; in-built automatic gain control circuitry provides the necessary accommodation, preventing overload and ensuring an appropriate level of signal through the system.

The audio is used to frequency modulate a carrier centred on 95kHz by up to plus and minus 50kHz. This is imposed, in turn, on the infra-red radiation from the LEDs, and made available to any or all infra-red headphone/receivers in the viewing room.

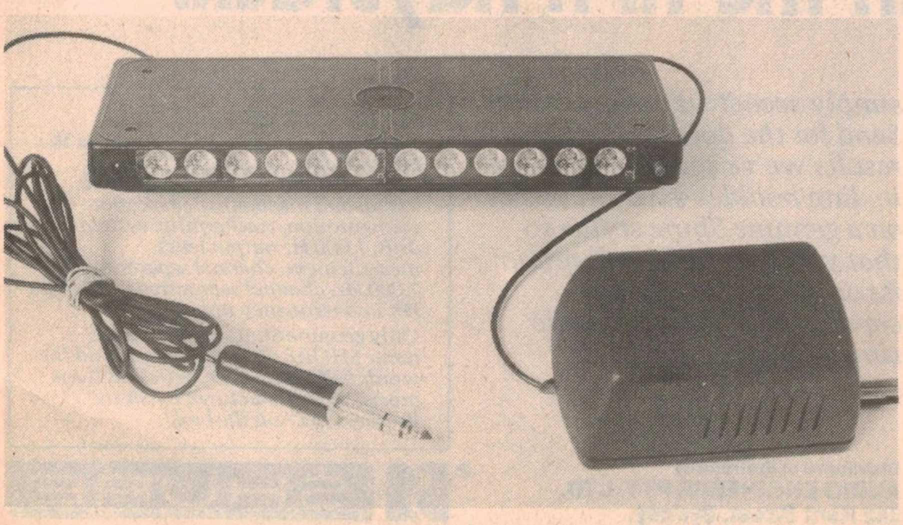
The mono infra-red receiver HDI-406, pictured in the February '76 issue is housed in a light moulding which is supported under the listener's chin by the stethescope phones. A single light sensitive silicon PIN diode behind a filter bezel picks up the infra-red radiation, the whole receiving circuitry being powered by a tiny rechargeable plug-in battery pack.

On test, the mono system performed exactly as Sennheiser had claimed, giving clean noise-free sound, unaffected by normal indoor natural or artificial illumination. Sound was available anywhere in the viewing room and was interrupted only by postures deliberately intended to hide the receptor diode from the transmitter and from surfaces likely to reflect the infra-red radiation.

For all practical purposes, sound was available anywhere in the viewing area and to any number of people wearing I.R. receiver/headphones.

For a variety of reasons, the original mono system was not heavily promoted on the Australian market but R. H. Cunningham Pty. Ltd., are now collaborating with Sennheiser to introduce the infra-red cordless headphone system to Australia under the title Sennheiser "INFRAPORT".

They are envisaging a variety of



The Sennheiser SI-434 infra-red stereo transmitter, as it will be sold in Australia, with power supply in the foreground and stereo phone jack to the left. The makers say that a working FM deviation of ±35kHz will result when the transmitter is fed from +6dB program line level, or just over 1V of AC signal. Input impedance is about 15,000 ohms.

applications for INFRAPORT units. For the mono version: cordless headphones for television viewing or ordinary radio listening; cordless headphones for patients in dental surgeries and other situations where selected music may reduce tension. With higher powered transmitters and phones: cordless hearing aids for people in churches, halls, auditoriums, cinemas, etc. Yet another possibility is for seminars and trade exhibitions.

The release of a stereo version opens up other interesting possibilities, but the main emphasis will probably be on domestic hifi listening.

The new "domestic" stereo model transmitter is designated as type SI-434. Measuring 200 x 80 x 17m, it contains two distinct channels, each involving six I.R. light emitting diodes, sufficient to "illuminate" any typical viewing room. An extra diode radiates visible light and serves the dual function of showing that the transmitter is "on", and indicating an appropriate order of carrier deviation.

And here the new hifi stereo version would appear to differ significantly from the TV type, which relies on automatic gain control to set the transmitter modulation level.

While a convenient scheme in some ways, AGC must inevitably compress the natural dynamics of the signal being processed, limiting crescendos and boosting the softer passages. Of no great consequence for TV sound, such artificial compression would be unacceptable for hifi listening

In consequence, instructions with the transmitter unit indicate that, after suitable connection is made to the audio signal source, the amplifier volume control should be adjusted so that the indicator diode produces brightness peaks which appear to relate to the amplitude of the sound signal.

While the European literature suggests two or three options for connecting the transmitter to the hifi equipment, the prototype Australian model pictured is fitted with a 6.5mm stereo headphone plug intended to go into the normal headphone socket.

The transmitter power supply—somewhat larger and heavier than the earlier mono supply, can be located in some out-of-the-way position, plugging into the power point by way of an ordinary length of flex. Power consumption at 240V is 10 watts.

Specifications indicate that the left channel transmitter operates on a frequency of 95kHz—the same frequency as adopted for the earlier mono version. The right channel is centred on 250kHz. Both are frequency modulated with up to 50kHz deviation, using a standard 50uS pre-emphasis. Rated frequency response is 20Hz to 20kHz (+0 and −3dB); harmonic distortion, less than 1%; signal /noise ratio not less than 60dB DIN; channel separation not less than 55dB.

The new HDI-434 stereo receiver/ headphone set is quite different from the

NEW HIFI PRODUCTS FROM AIWA

Sloping deck, Dolby/MPX, 3-way bias switching

AIWA's new cassette deck type AD-1250 offers the sloping panel look but with the advantage of a tilting perspex dust cover. It employs AIWA's oil damped cassette handling system and has auto-stop facilities, pause and quick review. With Dolby and MPX to cope with dynamic range, it also includes 3-way switching to suit normal oxide tape, Chromium-dioxide and ferrichrome multi-layer. The head is "ultra-hard permalloy" and the frequency response is to 14kHz or 16kHz, depending on the tape used.

5-Band full coverage cassete-radio

AIWA's radio-cassette recorder combination is notable for its wide and continuous coverage: four bands from 525kHz, the low end of the broadcast band through to 28MHz and taking in CB frequencies. A fifth band takes in FM broadcasting from 87.5 to 108MHz. It also features an in-built mono cassette recorder with AC erase, integral electret microphone and good electrical specifications. Operation is from AC mains, 5 internal D type cells, or from a car battery via a suitable adaptor cord.

For further information on these products, contact AIWA Australia Pty Ltd, 14 Gertrude St, Arncliffe, NSW 2205.

Disc, cassette facilities, AM/FM/SW radio

A really comprehensive package, AIWA's 3-way entertainment centre model AF-5050 includes a 4-band receiver covering AM, FM & shortwave, plus 150-340kHz. The amplifier has bass, treble, loudness and volume controls and offers 10 to 15W RMS per channel at 1% distortion at full output. The record player has belt drive, balanced arm and a magnetic cartridge, while the cassette deck includes all modern facilities.

4 of the best
from SENNHEISER

The **HD400** is the latest in the Sennheiser family of 'Open-Aire' headphones. Ultra light weight (under 3 ozs), they are extremely comfortable with foam ear pads that can be removed for washing.

Frequency response: ...20-20,000 Hz
Impedance: ...600 Ω
Weight: ...80 g without cable
Cable length: ...3 m

And now the **HD414X,** an improved version of the outstanding HD414 (more than One Million sold), with an extended frequency range. Fitted with washable foam ear pads.

Frequency response: ...20-20,000 Hz
Impedance: ...2,000 Ω
Weight: ...125 g
Cable length: ...3 m

The new **HD424X** offers more volume throughout its range, and greater comfort with a self-locking, adjustable headband, and washable foam ear pads.

Frequency response: ...16-20,000 Hz
Impedance: ...2,000 Ω
Weight: ...180 g
Cable length: ...3 m

The **HD224X** is a dynamic headphone fitted with two newly developed capsules providing excellent frequency response and reproduction. Gentle ear pads ensure sound proof listening.

Frequency response: ...16-20,000 Hz
Impedance: ...200 Ω
Weight: ...252 g
Cable length: ...3 m

Sennheiser presents "four of the best" stereo headphones they have ever produced, to give music listening pleasure an out of this world experience.

Unsurpassed in design and technological development, Sennheiser have combined the most wanted features with comfort, modern styling and faithful reproduction throughout the entire audio range.

Choose the headphones to suit you, from Sennheiser's "four of the best".

R.H. Cunningham Pty. Ltd.

VIC.: 493-499 Victoria St., West Melbourne 3003. Ph.: 329 9633. **N.S.W.:** 4-8 Waters Rd., Neutral Bay 2089. Ph.: 909 2388. **W.A.:** 256 Stirling St., Perth 6000. Ph.: 28 3655.
QLD.: L. E. BOUGHEN & CO., Cnr. Milton & Baroona Rds., Milton 4064. Ph.: 36 1277.
S.A.: Werner Electronic Industries Pty. Ltd., Unit 25, 28 Gray St., Kilkenny 5009. Ph.: 268 2801.
Telex: Melbourne, 31447. Sydney, 21707. Brisbane, 41500. Perth, 93244.

mono version. Whereas the mono phones were very light and unobtrusive, with stethescope extensions to the ears, the new stereo phones are quite large, without being proportionately either heavy (380g) or cumbersome. A padded surface rests against the ears, while an adjustable cushion strap inside the main headband adapts them to the needs of individual wearers.

The I.R. receiving PIN diode is housed under a filter lens on the front edge of the right-hand phone housing, so that it faces in the same general direction as the listener. Signal from the diode is transferred to the left housing, which contains most of the receiving electronics, plus a standard transistor style 9V battery housed in its own small compartment. Current drain is 4mA and approximate battery life 100 hours.

Sennheiser (overseas) literature mentions that a physically interchangeable NiCd rechargeable battery (Petrix Tr 7/8, &C) is available.

Control facilities for the phones are provided on the rear of the right housing. They include an off-on switch, independant left and right volume controls, and a switch which allows the phones to be used in two-channel mode, or to take a common output from the left or right channels, as desired. This gives the clue to Sennheiser's reference to the phones as "universal". Fairly obviously, they could be set to receive only from the left channel, making them compatible with the mono signal on 95kHz, radiated by the simpler "TV" type transmitter.

The remaining space in the two housings is, of course, taken up by the dynamic transducers, which are derived from those in Sennheiser's well known HD-424 stereo headsets. The intrinsic quality is therefore similar, while the sound pressure level available is approximately 108dB – high enough even for professional requirements. Other figures for the overall system are as given earlier.

While the domestic application is the most obvious one for the stereo headset, Sennheiser literature suggests other interesting possibilities.

Because of the excellent channel separation, the system can be used for two-channel applications, as distinct from stereo. In sound and television studios, production staff can wear phones with the program line output audible in one ear and directors or other instructions in the other—both subject to independent volume control. Studio musicians, working under electronic mix conditions, can likewise be provided with two channels of sound.

Yet another application would appear to be for bi-lingual conferences and exhibitions.

Again, those with hearing problems may benefit from wearing headphones, with the option of operating them at maximum level or individually adjusted for the best balance.

In fact, Sennheiser can offer special options for those with a hearing disability, who need something more than the standard IR phones turned to maximum level. As indicated in the earlier article, these options make it possible for people at public performances, church services, etc, to have an amplified version of the proceedings without having to be in seats wired for the deaf. The one requirement is, of course, that a suitable IR transmitter has been installed, illuminating the seating area.

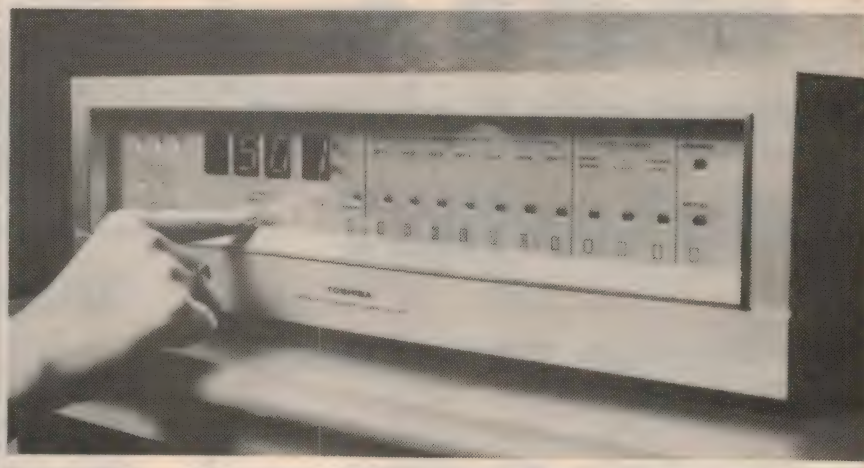
For such applications, Sennheiser have developed higher powered infra-red transmitters.

But, more importantly, how did we react to the new domestic hifi stereo model? How did it work? In one word, the answer is "fine". No lack of infra-red signal, no apparent noise, distortion or loss of response. If the idea meets your need, buy one and enjoy the result.

For further information on Sennheiser infra-red audio equipment, contact R. H. Cunningham Pty Ltd, 493-499 Victoria St, West Melbourne 3003, phone 329 9633. Also in other capitals.

IN TUNE WITH TOSHIBA-EMI

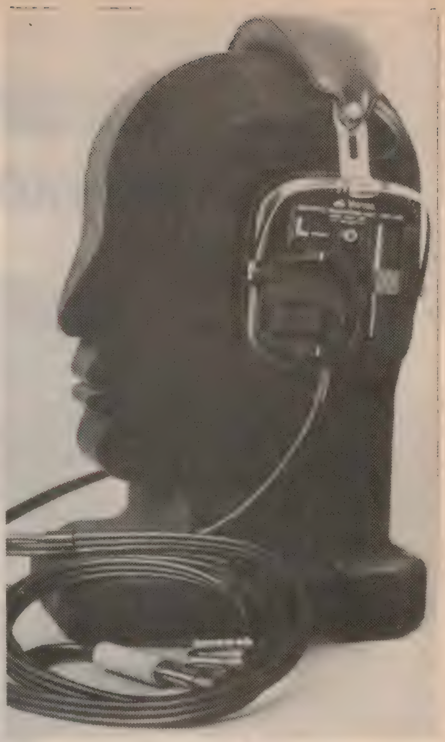
Wherever you see a Toshiba product, there's a pretty girl in attendance; at least that's the way it seems to be in the adverts. This portable radio/cassette recorder is no exception. Designated as model RT-2300, it operates from AC mains or internal batteries, and delivers an output of 1W to a 9.2cm speaker. Features include AM and FM coverage, in-built capacitor microphone, meter for battery condition and recording level and normal deck control facilities.



Toshiba's new glamour stereo FM tuner, model 910, almost missed out on the supporting charm with only a feminine hand showing. It was selected by the sponsors of the Chicago Electronics Show as a special innovative design exhibit. Conventional controls have been completely eliminated, its nineteen functions being actuated by merely touching the designated spot on the front panel. Seven presettable channels are provided for, but general tuning is accomplished by touching areas marked "Tune Up" or "Tune Down", the frequency at any time being indicated by an easy-to-read digital display. (Information on Toshiba products can be obtained from Toshiba-EMI (Australia) Pty Ltd, 16 Mars Rd, Lane Cove, NSW, 2066.)

JVC's new headphone / mic combination:

MAKE YOUR OWN BINAURAL TAPES



If you have $95 to spare, and a stereo tape deck on hand, you'll be able to try your hand at binaural sound recording and reproduction—this time by courtesy of JVC-Nivico and their HM-200E headphone-microphone.

Strongly promoted some years ago by Sennheiser, the binaural system seeks to place two microphones in the position a listener's two ears might typically occupy on an occasion or at a performance. The signals so obtained are recorded and later listened to on headphones, hopefully translating the listener back to the original scene. The end result is limited and personal because phones are mandatory. The sound can be very intimate, even startling, but it can also be subject to much argument.

Superficially, the new JVC HM-200E headset looks not unlike any other pair of stereo headphones; except that it seems to be loaded with rather more gadgetry and trails a triple cord ending in three separate 6.5mm jack plugs.

The headphone section is, in fact, fairly conventional: padded adjustable headband, two generously padded phones, what look like dome drivers behind a protective grille, a high/low sensitivity switch, and a cord terminating in a standard stereo phone jack. As such, the HM-200E can be used in any situation normally demanded of modern dynamic phones, and giving a very good account of themselves in terms of general quality.

Rated impedance is 8 ohms, frequency response 20-20,000cps, and sensitivity either 96dB/1mW or 86dB/1mW, depending on the setting of the sensitivity switch on the left-hand housing.

On closer examination, the moulding is seen to have a large recess opening forward and sideways, as the headphones are worn. In fact, the recess forms an acoustic cavity intended to gather external sound and conduct it to a tiny electret microphone within each of the housings. JVC engineers have obviously designed it to simulate the properties of a human ear.

The microphones are credited with a sensitivity of −67dB (OdB = 1V/ubar) and a frequency response of 40-18,000Hz. They are powered by two penlight cells, giving a normal life in excess of 1000 hours. A switch on the right-hand microphone provides a microphone "off" position, a microphone "flat" position, and a third position which reduces the bass response (typically −6dB at 100Hz).

JVC supply the headset complete with a dummy head—a stylised shape in a black, felted finish, and with a metal underplate which allows it to attach to a variety of microphone stands. When the headset is in position on this dummy, or being worn on a real human head, the microphones and earphones are sufficiently isolated, acoustically, for them to be energised simultaneously and operating in a common system.

The user may thus wear the headset with all leads connected to a tape deck and with the deck in recording "Pause" mode. In these circumstances the wearer may hear sounds of his left and right ostensibly natural but, in reality, being picked up by the microphones and fed into his ears through the phones.

If a tape is now operated, a recording will be obtained capable of being played back later, to recreate the original sound scene.

And here the arguments begin. Critics maintain that, while we can pick sound sources on the left and right by sound alone, we rely on other information to pinpoint sound approaching the front of back sector, or above or below:

1. Visual clues.
2. Sensing by involuntary and perhaps imperceptible movements of the head.
3. Interpretation of phase effects caused by each person's pinnas.
4. Interpretation of reverberant sounds assisted by (2) above.

None of these clues apply in a delayed binaural listening situation.

JVC have a demostration tape available to explain the concept of binaural recording and reproduction and we were able to borrow it from their distributor. We also made our own tape of a person moving around a room, speaking or playing music in various positions, whispering in ears, and so on.

Members of our technical staff were invited to listen to both tapes, preferably alone in our audio room, with eyes closed. The reaction was substantially uniform: very good quality, a startling degree of intimacy and "presence", but a difficulty in resolving front/back, above/below. To be sure, logic tells one that aeroplanes must fly above, and people on a stairway are out in front where the commentator so specifies; but ignoring those clues and concentrating on sound alone opens up the interesting possibility that the aeroplane and the people are really moving through one's head!

As a matter of interest, we dug out a couple of Sennheiser demonstration records, as discussed at some length in our October 1975 issue, pp 12-15. The same reservations were expressed there and were confirmed by further listening.

Be that as it may, binaural recording and reproduction has an intimacy all its own, that may appeal strongly to enthusiasts who like to take their recorders along to organ club meetings and other such activities. And, if you do want to play the tapes over loudspeakers, the microphones work fine as a stereo pair. They'll certainly be a conversation piece, sitting up front on their impassive black artificial head!

Looking back, we can hardly round off these remarks more aptly than by paraphrasing the final par. In our October, '75 issue: Who are most likely to invest in JVC's HM-200E headset? Enthusiasts who have the urge and the money to climb out of the hifi mainstream for a while, to do their own thing!

For further information: contact your local JVC dealer or the Australian distributors: Hagemeyer (A'Asia) B.V., 59 Anzac Parade, Kensington, NSW. 2003.

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LER 169

Complex stereo receiver from JVC has graphic equaliser and FM noise reduction

The JVC JR-S600 is the most expensive unit in a new range of receivers manufactured by the Victor Company of Japan, Ltd. Among its most distinctive features are dramatic new styling, graphic equaliser tone controls and dual meters for monitoring power output. Power rating is 120 watts per channel into 8-ohm loads.

Let us say, at the outset, that we were most impressed with the styling and presentation of this new JVC receiver. Of course some confirmed knob-twiddlers may not like it all—it doesn't have any knobs. Instead, there is a host of slider controls and push-buttons.

The receiver is large and heavy. Dimensions are 560 x 169 x 440mm (W x H x D) and mass is 18.5kg. Clearance of 120mm is required at the rear of the receiver to allow the AM rod antenna to be fully swung out if necessary for good reception.

All the pushbuttons are contained in a row along the bottoms of the front panel. Six of those buttons are dummies. In our opinion it would have been better if JVC had eliminated the dummies and provided more legible labelling. A muting switch would also be a worthwhile addition.

There are seven slider controls, five involved in the graphic equaliser controls. While the balance control slider has a detent for the centre setting, the five controls for the graphic equaliser have thirteen detented positions, each one corresponding with an approximate 2dB step in boost or cut. This makes settings easily repeatable, although it makes the centre setting harder to find. Maybe the centre setting should be defined with a stronger detent.

When the unit is switched on, the dial illumination reveals four meters. Two are the conventional signal strength and centre-indicating meters for tuning, while the other two indicate power output. Those who dismiss the power meters as panel decoration would be quite right—they really do jazz up the receiver.

Another natty cosmetic styling feature is the heavy finned side panels. These look like high power heatsinks, but they are actually plastic mouldings which function as lifting handles.

There is the usual array of input and output sockets on the rear panel. Also featured here are the response curves for the five band graphic equaliser and an antenna switch for the FM tuner section, which can switch out the external 75 or 300 ohm aerial and switch in an internal aerial instead. This employs signal pick-up via the mains and is very handy where an external antenna is not available.

Removing the top cover reveals that the JR-S600 is not just a box with dramatic styling. For a start there is a massive toroidal transformer, which must be the biggest in any receiver or power amplifier. Besides being physically very quiet it has very little flux leakage, so there is no problem with hum induction into cassette decks and magnetic cartridges. This is a very worthwhile advantage over high power amplifiers with conventional transformers.

Complementing the toroidal transformer are two large power supply capacitors which each have a value of 22000uF. They are camouflaged in our photo by a PC board mounted atop the pair (next to the transformer). This PCB accommodates the low voltage power supplies.

While it may appear that most of the circuitry is visible in the photograph, quite a lot of it is concealed. As an example there is the vertically mounted PCB immediately behind the graphic equaliser controls. And there are the FM and AM front ends and IF/detector boards, which are mounted underneath the multiplex decoder and FM noise reduction boards. So like many receivers, accessibility is not good.

Two large heatsinks stretch across the rear section of the chassis and the power amplifier PC boards are vertically mounted to them. There are four output transistors per channel. These are connected in a complementary-symmetry mode, with direct coupling to the loudspeakers. No circuit was to hand at the time of writing so we cannot comment in detail on this aspect.

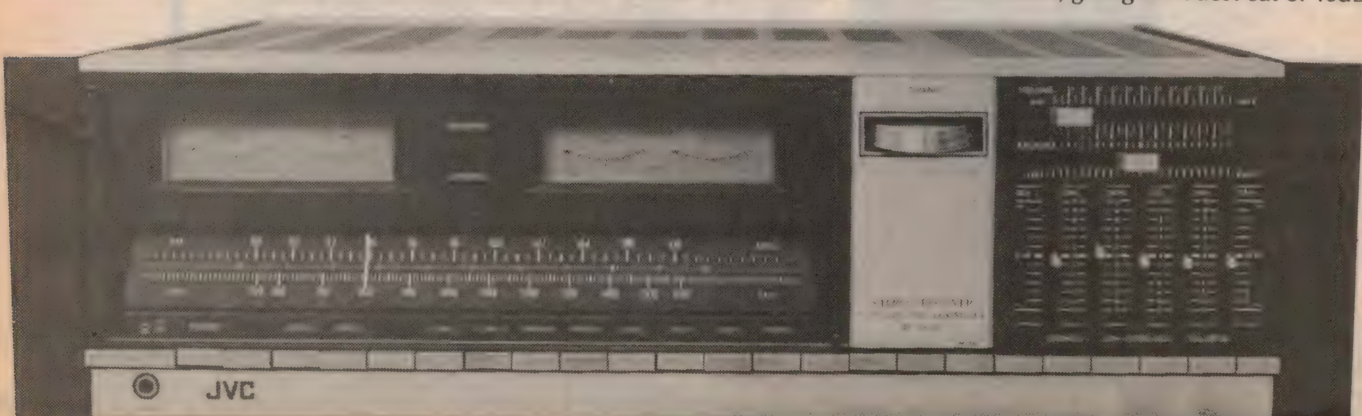
Comprehensive protection circuitry is included within the receiver. This is combined with circuitry to mute the amplifiers at switch-off and switch-on, via two relays.

The JVC JR-S600 complies with Australian standards. It has three-core mains flex, correct mains plug and 50uS FM deemphasis.

Power rating is 120 watts per channel into 8 ohm loads and 180 watts per channel into four ohm loads. This is with both channels driven. We had no trouble in confirming these ratings but we did have trouble measuring distortion. Highest measurement was 0.15%, while under most conditions THD was unmeasurable with our equipment.

Power output into 16 ohm loads was 72 watts per channel with both channels driven.

Frequency response was within 1dB from 8Hz to 31kHz. Filter slopes were 6dB/octave, giving a modest cut of 10dB



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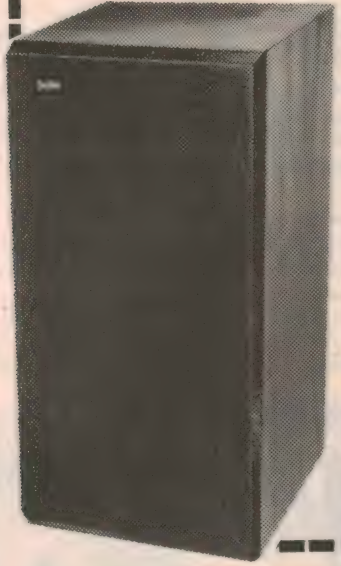

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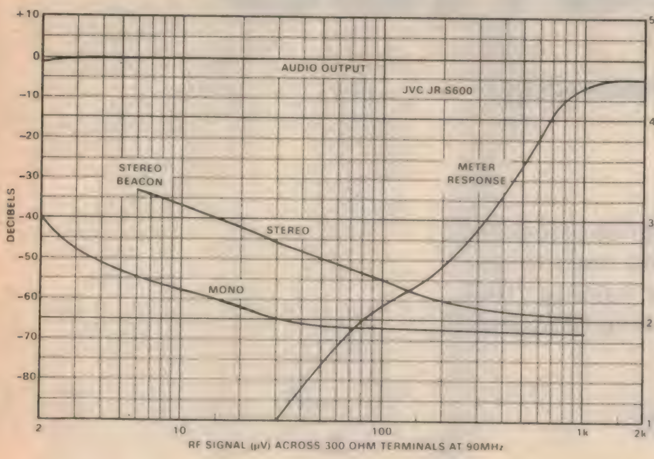
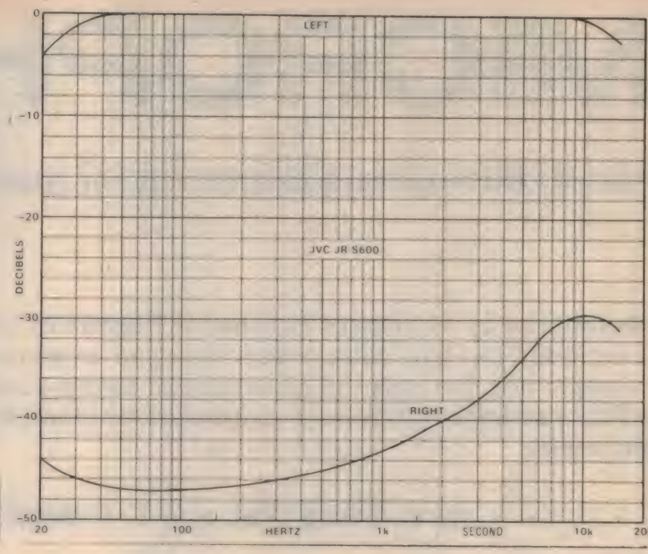
JVC JR-S600 STEREO RECEIVER





at 10kHz and 9dB at 50Hz. These filters should be much steeper in slope, or else deleted. Signal to noise ratio was 92dB unweighted for the AUX input while for phono it was 81dB unweighted with short-circuit input with respect to 120 watts and a 10mV input at 1kHz. This figure deteriorates to 72dB with a typical magnetic cartridge fitted. That is still very quiet, of course.

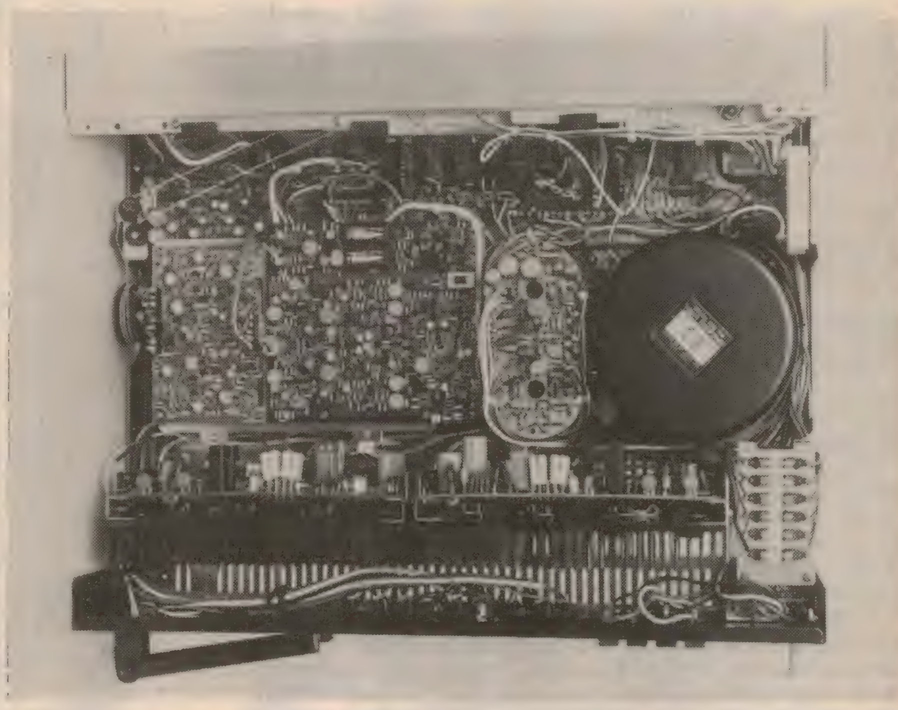
RIAA equalisation is within ±0.5dB over the range from 50Hz to 15kHz. Phono sensitivity is 2.5mV at 1kHz for full power, while the overload point at the same frequency was at 270mV for a THD reading of 0.1%. That degree of overload margin is really gilding the lily as there is no possibility of any magnetic cartridge delivering half that voltage!

FM Quieting performance is shown on the graphs and is typical of a good quality tuner. Separation between channels was excellent. Notice also that the frequency response is flat to below 50Hz. There is no "multiplex" filter. The FM noise reduction facility is intended to be used with Dolby FM broadcasts.

19kHz residual is −63dB while 38kHz subcarrier and harmonics are well below the ultimate signal-to-noise ratio of 64dB. Harmonic distortion measurements at full modulation were 0.18% at 100Hz, 0.2% at 1kHz and 0.23% at 6kHz in mono mode. In stereo, the readings were 0.35% at 100Hz, 0.3% at 1kHz and 0.25% at 6kHz. These are better than average figures.

In use the JR-S600 is a pleasure to drive. All controls are smooth and progressive and the graphic equaliser controls certainly have more range of control and effect than normal controls. The manual is quite useful in its suggested settings for different sound effects, although purists may argue that it amounts to a lot of gimmickry.

We would have preferred to have a large tuning knob rather than the thumb-operated wheel. A similar comment could apply to the volume control but we cannot argue with the suitability of sliders



for the graphic equaliser controls. They also have the benifit showing the approximate system response for given settings (hence the name "graphic").

Residual noise of the unit is very low at all control settings and the power output is more than adequate to drive all but the most inefficient loudspeakers. Overall, the JVC JR-S600 is a very attractive package—albeit quite expensive, especially after the effect of the recent devaluation. Recommended retail price is $999.

Further information and demonstration of the JVC range of equipment can be obtained from high fidelity retailers throughout Australia. Trade enquiries should be directed to the Australian distributors for JVC, Hagemeyer (Australasia) B.V. at 59 Anzac Parade, Kensington, NSW 2033, or intra and interstate offices. (L.D.S.)

MICROPHONES

Part 6: Microphone placement for mono recording

Reproduced by courtesy of Sennheiser Electronics, this series of articles is intended to assist sub-professionals and amateurs who need to use microphones, but lack the advantage of formal acoustic training. This article discusses microphone placement for mono recording of speech and music.

by G. PRAETZEL and E. F. WARNKE*

When a microphone is used at a short distance from the source of sound—speaker, vocalist, or musical instrument—we are working well within the "Hallradius" distance. (Part 1, October 1976.) The recorded sound, particularly speech, will be quite accurate, easy to follow, and might even be described as intimate. But it will also be rather lifeless and uninteresting.

If the distance between the speaker and the microphone is gradually increased—with the gain of the recording amplifier corrected appropriately—the ratio between the direct and reflected sound shifts continuously, up to the "Hallradius" distance.

Beyond this distance the reverberation prevails and the intelligibility becomes significantly impaired. On the other hand, within this radius, and approaching it, the voice acquires a liveliness and character which tends to reflect its surroundings. In most cases this is aesthetically desirable, though the exact amount of reverberation required will vary with the subject matter.

Which brings us to the various considerations governing the amount of reverberation likely to be recorded in any particular set-up. A major factor is the characteristic of the recording microphone. An omnidirectional microphone is least critical in this regard, since it simply records the ratio of direct to reflected sound at its position, regardless of its orientation.

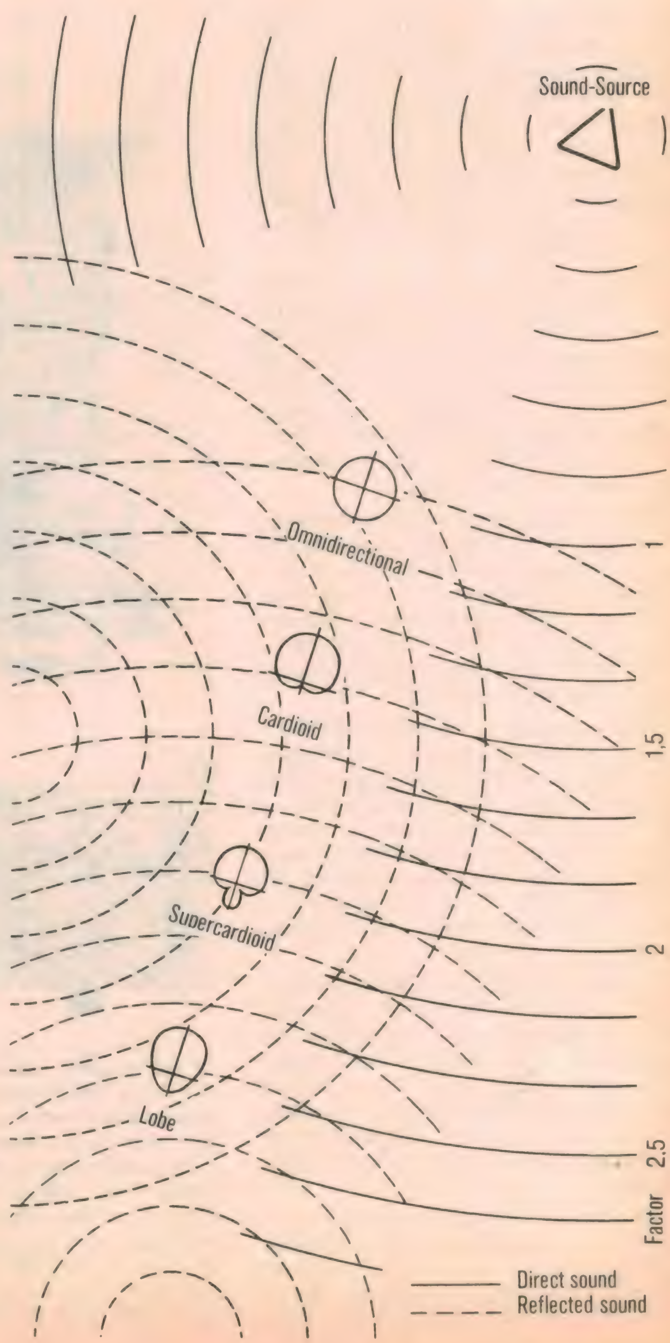
A directional microphone behaves quite differently. When it is orientated towards the sound source the direct sound is favoured over the reflected sound, in varying ratios according to the type of microphone. For example, the cardioid type microphone, such as the MD421, records the same mixture of direct and reverberant sound at a distance of approximately 1.5 times that needed for an omnidirectional type.

A super-cardioid type microphone, such as the MD441, is even better. It will record the same ratio at twice the distance. Highly directional, or lobe, type microphones, such as the MHK415, are better again. They can work at up to 2.5 times the distance needed for an omnidirectional type.

To these two factors—distance between microphone and sound source, and directional characteristics of the microphone—can be added the room acoustics. These are the three main factors which affect the reverberation content of the final recording.

As already implied, speech recordings which do not call for any special effects are best made at a minimum distance; between 10 to 20cm. This ensures a minimum of background noise, reverberation, etc, and maximum intelligibility.

At this distance, highly directional microphones tend to unduly emphasise the low frequency response, which may give the voice an unnatural quality. Where the microphone is fitted with a bass attenuator switch this will normally solve the problem. Alternatively, it may be necessary to substitute



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an omnidirectional type.

As opposed to the close talking technique, deliberately increasing the distance can be used to advantage where it is desired to capture some of the atmosphere surrounding the speaker, or to heighten the dramatic effect.

Basically, the same considerations as apply to recording speech also apply to recording music. If we locate the microphone very close to the musical instrument we obtain a very direct sound and, as we move the microphone away, we record more and more of the reverberant field.

While the close-up technique provides good presence, it is very desirable to include some reverberation in musical recordings. To make a good recording we must strike a balance between these two factors. Another risk inherent in close working is that of recording "operation noises" of the instrument itself; key noises in woodwind instruments, scraping or scratching noises in bowed string instruments, or handling noise in percussion instruments. And, as in speech recording, close working with directional microphones can over-emphasise the low frequencies.

Another factor to be considered is that musical instruments have distinct radiation patterns, so that there is usually an optimum position (as distinct from distance) which should be satisfied if all the instrument's delicate sounds are to be captured. More will be said about radiation characteristics of various instruments in a later article.

In discussing mono recordings of groups of instruments we will assume the use of a single microphone, on the basis that the amateur is unlikely to have access to costly professional mixer equipment. Also, that the recording room may have less than ideal recording characteristics.

It will therefore be necessary to determine, by experiment and rehearsal, an arrangement which achieves, first, the correct balance between the instruments themselves and between the instruments and the soloist. As a general rule, the louder instruments should be located furthest from the microphone, and the softer instruments closer to it, but this rule may be modified according to the musical importance of particular instruments.

In addition to locating each instrument at the most suitable distance from the microphone, relative to the other instruments, it is necessary to find the best distance between the group as a whole, and the microphone, in order to achieve a desirable reverberation content.

A somewhat more subtle aspect of microphone and recording techniques is what is commonly called "presence". This is the deliberate accentuation, by a small amount, of the harmonic frequencies which, as we learned in an earlier article, lie between about 1000Hz and 4000Hz.

This technique can be justified on several grounds; some technical, some purely subjective. For example, it may be found that, when a desirable amount of reverberation has been achieved, there has been some loss of these more subtle harmonics.

Again, the loss of visual impact which may have been present at the original presentation needs to be offset, as does the lack of spaciousness in a mono recording.

In any case, whatever the reason, professional recording engineers frequently employ this trick to enhance the subjective quality of their recordings. To do this they usually employ specially designed filters.

While the amateur may not have such facilities available, he can achieve a similar effect by choosing a microphone having a natural boost over this part of the spectrum. A typical example is the MD421, the response of which was shown in Part 3 of this series, (December, 1976).

In the final analysis, it will be the experienced ear of the recording technician which will decide when all these factors have been satisfied in the best possible way.

From all the above it is probably obvious that, while the amateur can achieve very satisfying results using mono recording and a single microphone, such results are not easily achieved. In the next part of this article we will look at the various aspects of stereo recording.

"Throughout history, all change has been resisted"

The argument for nuclear energy

This article is from an address by Sir John Hill, Chairman of the United Kingdom Atomic Energy Authority (UKAEA), and was given at a conference on "Nuclear Power and the Public Interest—the Implication for Business" in London last July. In view of the raging debate currently taking place in this country on uranium mining, and the nuclear industry in general, the following arguments should be of interest to a great many readers.

I have been asked to present a paper with the title "The Abuse of Nuclear Power" but this title can, of course, be read in many different ways. The threat of nuclear attack by one country on another would obviously be the abuse of nuclear power. The development of nuclear weapons by any additional country would today be regarded as an abuse of nuclear power because it could provoke another country to do the same thing and lead to further proliferation of nuclear weapons.

Abuse of nuclear power could mean terrorists attempting to steel plutonium to make a crude nuclear weapon or to contaminate the environment as an act of blackmail. Abuse of nuclear power could also mean the careless use of nuclear materials leading to contamination of the environment or unjustified hazard to employees or to the population. Finally, the abuse of nuclear power can just as much refer to the uninformed and misleading attacks to which the nuclear industry is frequently subject. I will try to cover these different aspects and give my own views of the relative importance of these different problems.

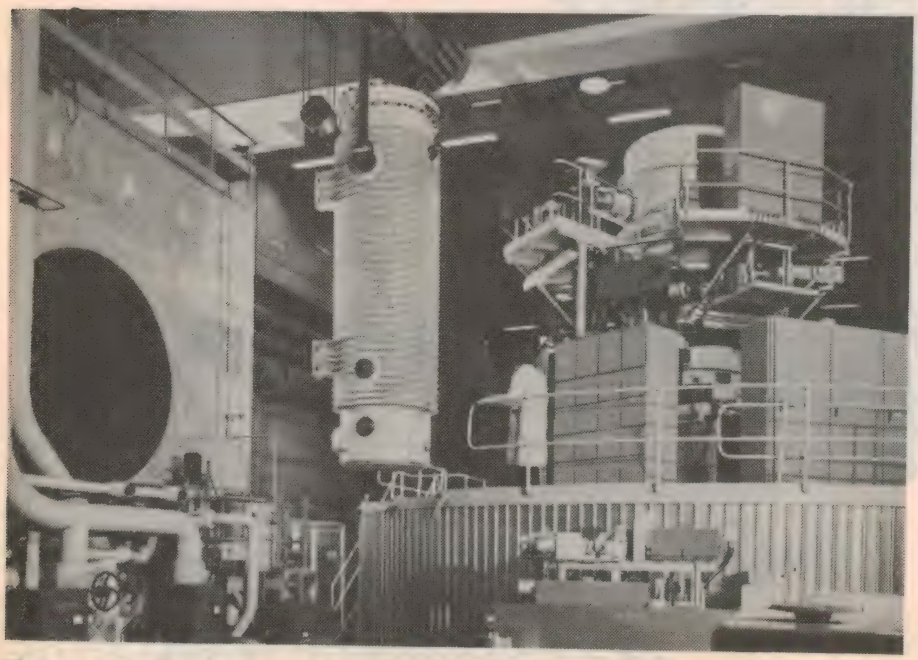
The whole history of mankind since the start of civilisation has been influenced by the continued search for greater power; e.g., the introduction of oxen for ploughing and riding the horse as an alternative to walking; the use of fire to keep us warm and the waterwheel to augment the strength of the human arm; the use of coal to make iron and the introduction of the steam engine for pumping water and powering the railways; the introduction of the motor car and the aeroplane. All these steps gave more power to man's elbow, raised his standard of living and made it possible, for example, for Britain to support ten times the population that it could support before the industrial revolution.

The reason that mankind has become the dominant species on Earth is because he is the most adaptable to his environment. He has been able to change most rapidly to changing circumstances and he has been able to use to his advantage changes and opportunities as they occurred. But evolution in nature is very slow and on the timescale of industrial development mankind is still very conservative indeed. He is acutely suspicious of what he does not understand and is very resistant to any change in a period of his own individual lifespan.

Throughout history, all change has been resisted. Take for example the bitter opposition to the building of the railways by the environmentalists who, three generations later, are arguing that they should be subsidised to prevent them from being closed down; or the man with the red flag walking in front of the motor car.

But all change has advantage and disadvantage. It has always been possible to point to some aspect of the past and compare it with some unsatisfactory aspect of today. But the overall balance of these changes over the years has been overwhelmingly in man's favour.

The promise, and the problem, of nuclear power is that it is not only one more step along the path that mankind has been following since civilisation began, it is also a fairly big step. Each step in the past frightened people at the time, and this step, brought vividly to



The reactor hall of the Steam Generating Heavy Water Reactor (SGHWR) at Winfrith, Dorset. The 45-ton transport flask for irradiated fuel is shown in transit.

everyone's attention by its being introduced by the dropping of the atomic bomb on Hiroshima, has frightened correspondingly more.

Let us then look at nuclear energy as another source of power put at the disposal of mankind, which, as with all other inventions, can be used for good or ill, used or abused. Without the wheel we would not have had tanks, mobile guns, railways or the motor car. Without chemistry we would not have had bombs, shells, drugs for our hospitals or fertilisers. Without nuclear physics we would not have had the atomic bomb, plutonium or the availability of virtually limitless power to support us when our precious reserves of oil and gas have been squandered, squandered in a way that will cause bitter resentment by future generations. Let us look then at the various aspects of the use and abuse of nuclear power.

We may or may not regret the invention of the atomic bomb but we must accept that it is a reality. It has been developed independently by the United States, Russia, the United Kingdom, France, China, India and probably Israel.

More important still is the fact that many countries have the scientific, engineering and technological skill to develop nuclear weapons or peaceful nuclear power programs themselves. Furthermore, they will be more likely to do so if they are denied nuclear power by the countries that have it today. There is no way that this knowledge, which is now world wide, can be uninvented. This is a fact and we must learn to live with it.

The problem of proliferation of nuclear weapons is in my view far and away the most worrying aspect of nuclear power. Governments, responsible or irresponsible, depending upon your point of view, have the possibility of obtaining weapons of devastating power. The solution to this problem is political and international. It will not go away by banning the construction of nuclear power stations. Great progress has been made through the International Atomic Energy Agency of the United Nations and the Non-Proliferation Treaty has been signed and ratified by an encouraging number of countries.

Achieving the maximum degree of acceptance of the Non-Proliferation Treaty remains in my view the most important political objective in nuclear power. The Non-Proliferation Treaty may not be perfect but it is a major step in the right direction.

I believe the world has less to fear from nuclear terrorists. In spite of what has been written I remain of the opinion that committing an act of nuclear terrorism would be one of the most difficult ways of achieving terrorist objectives.

It is unfortunate that we have so much terrorism in this world and that we have got to take all the steps we do to ensure that it does not succeed in the nuclear field. But the nuclear industry is a responsible industry and the governments that control it, in their respective countries, are increasingly insistent that adequate precautions are taken. Certainly, in Britain, I am satisfied that the precautions we are taking today are adequate for the circumstances of today.

The nuclear industry in the UK acts from the point of view of buying and selling its services as a commercial company. The more sensitive parts of it, such as the factory at Windscale, are, however, from the point of view of security still treated as if they were defence establishments. The careful selection of staff, the fences, the design of the plutonium vaults and the arming of the security guards are all carried out to the instructions of the government security services. It is these government security services which ultimately carry the responsibility for determining the level of security and defence employed on establishments such as Windscale.

Even the critics of nuclear power admit that the situation today is not too unsatisfactory and they direct their main criticism at the situation that might apply towards the end of the century when our nuclear program will be perhaps ten times larger than it is at the present time. They contend that with the very much larger movements of plutonium and the increases in the amounts of radioactivity being processed, the situation could get out of control.

At top is an external view of the SGHWR at Winfrith while above is a view of the control room. The reactor was completed in 1967 and generates 100MW.

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CASTLE 8RS DD.

The Castle 8RS DD is a highly sensitive eight inch unit covering the frequency range from about 50Hz (depending on cabinet size) to 20 kHz.

Suitable for use with good quality stereo systems, tape recorders, car radios, public address and background music systems.

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The argument for nuclear energy

I would be the first to agree that the plants that we have at our disposal today will not be satisfactory for the requirements of 25 years hence, but I would contend that in this period of time we will improve our processes in line with the requirements placed upon them and that the situation at the end of the century will not be worse, but if anything will be better than the situation that we have today.

The last subject I would like to turn to in this address is the abuse of nuclear power by our critics, particularly in relation to the hazards from plutonium, the health of nuclear employees and the possible damage to the health of the public at large.

The discussion about plutonium is far more emotive than rational. It has been said that plutonium was named after the god of the devil; that is untrue; it was named after the outermost planet of the solar system.

It has been said that plutonium is the most toxic material known to man; that is untrue. It is certainly a nasty material to handle and this gives rise to major problems in the design of plutonium plants. But it has nothing like the toxicity of some of the poisons of the spiders and other insects, and it is not significantly worse than the toxicity of many chemicals.

From the point of view of eating or drinking, plutonium is less toxic than many chemicals in quite widespread use. The particular hazard from plutonium is inhalation of plutonium dust into the lung where less than a milligram can cause lung cancer. But the issue is not whether plutonium can cause lung cancer: we know it can. Many materials can cause lung cancer. The real issue is whether plutonium does currently cause lung cancer.

But before I come to diseases of the lung, which is a very wide subject, could I just mention the disease leukaemia. Leukaemia has been associated with atomic energy; whenever there is a leukaemia death in any atomic energy establishment, there is a national outcry with the implication that another person has been killed by plutonium or by radiation. But have any of these people who write about leukaemia deaths and atomic energy actually studied the statistics? Our leukaemia statistics are no worse, in fact they are somewhat better, than the population at large.

If we look at the Registrar-General's Decennial Supplement, where the statistics for all industries in this country are analysed, and look to see which industries have got the highest leukaemia rate, what do we find? At double the national average: upholsterers and related workers; and just over double the national average: workers in textile fabrics and related products. Do we really believe that upholstery causes leukaemia? It's possible, but I believe unlikely. Before meaningful conclusions can be drawn there must be some reason why we should suspect that a particular substance or a particular industry should cause a particular disease and also have sound statistical evidence to back up the case.

Anybody who has taken the trouble to study the Registrar-General's report will rapidly come to the conclusion that small variations from the national average for the death rate for individual diseases is meaningless. But in some cases the divergences are so large that they are meaningful and indicate the relative health or otherwise of different industries.

An objective study of the statistics would convince anybody that the skilled industries have a better life expectancy and a lower death rate than the unskilled industries, and particularly the dirty unskilled industries.

So what about atomic energy? Yes, certainly there is plutonium and certainly there is radiation. But atomic energy is a skilled industry; it's an industry of laboratories, clean chemical plants and the highest quality of light engineering. If one compares the statistics of atomic energy workers with people doing the same type of work in other industries, in other words, laboratory work, chemical plants where the conditions are clean and hygienic, and the highest quality of light engineering, we find that the statistics are remarkably similar. Atomic energy is one of the best of industries to work in, a clean industry with good working conditions; an interesting industry where the employees take an interest in their work and, just as important, they take an interest in themselves and, perhaps encouraged by the works doctors, look after their own health. Our health statistics are good and I think better than any other industry producing the energy we require.

To those of our critics who argue against atomic energy on health grounds, I would say to them: "What alternative do you recommend and what statistics can you produce to show that your solution would give a better outcome than atomic energy?"

Attacks on atomic energy by people who have not studied the facts, who have not taken the trouble to look at the statistics are to my mind abusing atomic energy. They are also doing a national disservice. I am willing at any time to discuss the facts, our records, what we are doing, what discharges we make to the environment and compare the effect of nuclear power with that of any other solution to the world's energy needs that people may seriously propose.

Fast breeder reactors are expected to be the major nuclear power producers from the 1980's onwards. Above is view of the UKAEA's 250MW Prototype Fast Reactor at Dounreay, Scotland, with the Dounreay Fast Reactor on the right.

Reprinted in abbreviated form from "Atom", monthly information bulletin of the United Kingdom Atomic Energy Authority.

Australian research will aid weather prediction

Experimental radar for ocean surface studies

Australian scientists at the James Cook University of North Queensland, Townsville, have designed a HF Doppler radar for use in determining wave conditions over large ocean areas. The aim is to derive, by a remote sensing technique, sea state parameters that may be used as an aid to weather forecasting. Other possible applications of the radar are tracking and interrogating ocean buoys, tracking radio noise associated with tropical cyclones, and investigating aspects of ionospheric dynamics.

by J. F. WARD* and P. E. DEXTER**

The study of HF radar backscatter echoes from rough ocean profiles as a possible method for the remote determination of surface wind conditions is of considerable interest in radio physics, oceanography and synoptic meteorology. Crombie (1955) demonstrated the existence of such ocean echoes and gave a simple interpretation. His work was extended from a short-range surface-wave propagation path over the sea to a long-range ionospheric mode of one or more hops by Ward (1969), who achieved successful power spectra analyses for data at Townsville that was derived from ocean regions south of Hobart: a range of approximately 2800km.

Although the fixed array used in these early experiments had a beam which could be slewed electrically over a small arc, it became clear that flexibility in selection of ocean targets was a prime requirement for further progress. As a result, a major coherent radar installation operating at 21MHz was designed and set in operation at Townsville by the James Cook University, and was officially commissioned by the Director of the Australian Bureau of Meteorology in 1973.

An extensive experiment of over one year's duration, essential to the design, was carried out in 1971-72 to study typical ionospheric dynamics in relation to phase path instability. This yielded one parameter in the specification of performance possible in the radar (Ward 1972). Besides specific observations of target regions of interest in various oceans surrounding Australia, a series of systematic observations of the Tasman Sea between Auckland and Sydney was undertaken.

The broad object of the study now in progress is to designate the degree of correlation between accurately known ocean conditions and the sea state as derived at a remote location by the radar probing and analysis.

The operating frequency of the radar of 21.840MHz (λ_r = 13.8m) was chosen to be as high as the *F* layer would sustain for oblique modes during daylight hours when the normal ionosphere was expected to be in its most stable condition. A compromise between propagation needs and aerial directivity had to be made.

For resonance with the ocean-wave backscattering region, a sea wavelength λ_w of $0.5\lambda_r$ (6.9m) was thus necessary. This yields the Bragg resonance line in the spectrum (Crombie 1955). Reasonable aerial directivity and gain could be expected for the physical dimensions thus imposed, but the consequent value of λ_w is shorter than that for the peak in the energy-wavelength spectrum of a fully developed wind-driven ocean wave system. Experiment has shown, however, that adequate return signals can be attained to meet the needs of the extremely narrow band detection systems used in the coherent radar.

The aerial array consists of an interferometry pair of two sets of unbalanced monopoles which excite (as distributed feeds) two large corner reflectors (3.0 × 0.5λ). The design configuration was optimized by model studies at 1000MHz, and the resultant HF radar version was scaled up by 50 : 1 to operate at 21MHz. The array (see Fig. 1) is based on the very much larger low-delta designs studied and constructed by Ward. With its associated earth plane, this version is completely rotatable in azimuth, with a setting accuracy of ±0.25° and a final bearing accuracy of ±0.5°.

A gondola carrying the high-power radar transmitter and ancillary controls is suspended below the earth plane to rotate integrally with it. The moving structure weighs approximately 20 tonne and can traverse 360° of azimuth very smoothly in 3 min. The cliff top location of the station was chosen to give unobstructed sea horizons in all directions of interest, so that near-grazing angles of fire and reception would permit single-hop *F*-layer ionospheric propagation modes with ranges approaching the 4000km theoretical limit.

Studies at UHF have indicated modifications which could be applied to adjust the vertical (*E*) plane polar-pattern if the sea ray interference due to the cliff height of 2λ above the sea proved to be troublesome for some target ranges of particular interest. In practice this has been found unnecessary, and all ranges from the skip distance out to about 4000km appear to be attainable in the first-hop mode. Echoes from two-hop paths out to 6000km have been noted, and enough coherence has been found within these to warrant further study. A typical A scan portrayal showing sea echoes suitable for analysis is given in Fig. 2.

As the radar operates in the monostatic mode by means of a TR aerial switch, an effective side lobe suppression of the order of 15dB with respect to the main lobe is attained operationally, and this is

*Physics Department, James Cook University of North Queensland, Townsville, Qld 4811.
**Australian Bureau of Meteorology and Physics Department, James Cook University of North Queensland, Townsville, Qld 4811.

found to be adequate to ensure that the phase coherence of the overall system is controlled by the energy received within the main beam only.

As the receiving processing equipment utilizes phase lock procedures with long electrical time constants, there is evidence that the final coherence is achieved by the time-statistics of the strongest echo contributions. This means that the effective dynamic beamwidth of the array may be narrower than that based on the 3dB criterion, as quoted above. This dynamic property improves resolution in both the range and azimuth dimension.

The particularly high front-to-back ratio of approximately 20dB is an important operational feature of the array, for which the forward gain is 13±1dB with respect to a free space dipole. When outphasing is applied within the main lobe of the interferometric pattern it gives a null which is useful for direction-finding purposes to yield an angular resolution of much less than 1° of azimuth. When driven with a transmitter of output 20kW peak pulse power, the field strength measured by one of us (J.F.W.) at Singapore in December 1972 was comparable with that of Radio Australia, Radio Cologne and the Voice of America; all of which were on adjacent frequencies.

The effectiveness of the array in a possible short-wave broadcast role to achieve service areas by one- or two-hop modes for any chosen azimuthal direction is obvious. In the radar mode the present transmitter with the array can yield an effective radiated power of up to 0.5MW. Pulse lengths of 0.5-1.0ms duration and repetition periods of 40 or 80ms are available

Owing to flexibility in the choice of the region of ionosphere to be illuminated, the coherent radar is a very useful instrument for studying the dynamics of the ionosphere as such and, in particular, for performing morphological studies of travelling ionospheric disturbances (experiments of this kind are currently being carried out). In conjunction with the Bureau of Meteorology, we have used the array in simulated experiments on tracking and interrogating free-floating instrumented buoys. The array is also being used to study the morphology of ionospherically propagated HF radio noise at about 20MHz associated with selected equatorial regions.

Interesting results have been obtained from the tracking of distant tropical cyclones by virtue of their generation of significant localized radio noise in a band capable of ionospheric propagation.

The optimum times for using the ionosphere as part of the transmission path in an extended-range coherent radar have been determined diurnally and seasonally by Ward (1972) from a sustained series of phase path measurements, which yielded statistical data based on more than 2000 separate

Fig. 1: General appearance of the Long Range HF Ocean Radar, Townsville, Qld.

Doppler frequency measurements extending over an observation time of more than one year. The resolution limit imposed by the dynamics of the ionosphere is predicted from this ancillary experiment to be ±0.01Hz. Ideally, during radar probing, there should exist a means to monitor independently the phase path fluctuations introduced by the ionosphere at the reflection regions in the latitudes of interest. Aberrations due to travelling ionospheric disturbances could then be excluded or minimized.

Correction for phase perturbations introduced by multi-path modes in the propagation path can be carried out effectively in the signal processing equipment by electronic logical decisions based on both the fade depth and the rate of fade parameters. This is a form of electronic editing of the data in real time. For observational samples of duration 100s or more, however, the spectral analysis operation applied to the data tends to minimize this problem by suppressing the perturbations and thereby lowering the backgroung phase 'noise'.

The amplitude–time analog output from the synchronous detector contains contributions from all Doppler phase

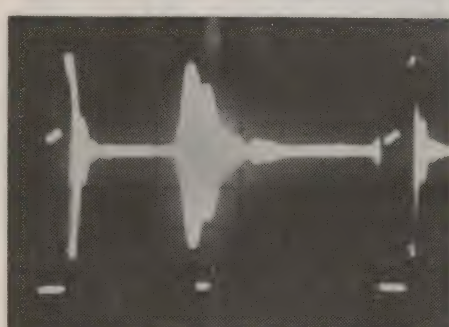


Fig. 2: Typical A scan sea echo group with amplitude limited transmitted pulse for timing. Repetition period is 40ms, with gating samples indicated in the lower trace.

shift components in the incoming echo signal. A second phase-sensitive detector yielding a ramp-function output is used to indicate, by the positive or negative gradient of the ramp, the sense of the Doppler frequency shift, ie, decreasing or increasing.

As a result of this type of data processing, spectral lines can be resolved to at best the limit of ±0.01Hz imposed by the instability of the propagation medium when conditions are near to ideal. Such a result for the 21MHz irradiation frequency corresponds to a measurement of Doppler shift to approximately ±5 parts in 10^{10}. Data taken from successive azimuthal bearings in the form of arc samples of 10°-20° and for radar ranges increments of about 150km (as determined by the choice and gating-out of viewing samples with different propagation times for selected target regions) comprise the basis for the computation and subsequent derivation of a matrix of target conditions leading to ocean surface predictions of meteorological significance.

Thus, for an observationally quiet period of about 2 hours per day, it is expected that about 100 observation regions could be probed and that spectra from these could be produced within 2 – 4 hours of the time of measurement to make available for meteorological interpretation a significant matrix of ocean data almost in real time.

The principal method of data collection currently employs magnetic tape as a means of temporary data storage, although this stage could be eliminated in future by introducing on-line data processing. The time-dependent phase-amplitude data, in the form of a time-varying DC signal (low pass filtered to 1Hz), is used to frequency modulate a signal up to 10kHz, and the result is then passed to the magnetic tape. Subsequent decoding back to the time-varying DC signal (0=10V) is necessary before digi-

(Continued on page 117)

The Consumer Comes Face to Face with the Computer

Last month, we discussed the new breed of computer systems now being introduced in the retail and grocery industries. This article completes that discussion by explaining the systems that will handle funds in banks and other businesses in the move towards a less cash/less check society.

by ZANE THORNTON*

*Deputy Director of the NBS Institute for Computer Sciences and Technology.

Gertrude Stein once said that money is always there but the pockets change. Moving money from pocket to pocket, or from account to account, is a gigantic task. Consider these figures (from the National Science Foundation Report C-76397, January 30, 1975) concerning the American economy:

- 250 billion financial transactions are carried out annually.
- 27 billion checks were written in 1973. Processing these checks cost the banking industry $5 billion, with a total cost to society of $10 billion.
- 20-25% of Americans carry bank credit cards, with a total of over 35 million card-related accounts.
- 16% of retail sales involve credit cards.
- $45 million is spent annually to manufacture money. $90 million is devoted to armored car operations and $430 million goes to protection agencies.

This computer terminal permits bank transactions 24 hours a day. The customer can withdraw cash, make deposits, and transfer funds between accounts.

In short, the money game is a complex and expensive operation, and there is great interest in streamlining the payment system. Solutions based on electronic funds transfer (EFT) offer vast potential in this field, providing the financial, technological, regulatory, and social issues can be sorted out.

Would widespread use of EFT mean that the "cashless/checkless society" predicted by some people a few years ago would become reality? No, but we would most certainly become a "less cash/less check society". Personally, I hope that term is just a shorthand notation for a better way of doing business, and not a reflection of my own balance sheet.

Let me give some examples of EFT, and some potential problems as well. Your salary could be paid by a system that automatically debits your employer's account and transfers the salary to your personal bank account. The U.S. Government, one of the nation's largest checkwriters, is already moving in this direction. The Social Security Administration, which issues nearly 43.5 million payments worth $7.8 billion per month, is automating its payments, and other Federal recurring payrolls are expected to follow.

The consumer may also encounter EFT in the department store and supermarket. In this mode, you could pay for purchases by authorizing an on-the-spot transfer of funds from your personal check account to the retailer's account at a local bank.

Another approach—the buck passer or customer-bank communications termi-

nal—involves direct operation. First you would initiate a transaction by inserting an identity card and entering a secret code number or pass word. Once "on-line", you could then withdraw cash, make a deposit, or transfer funds between accounts. Instructions displayed on a screen at the terminal would guide you through the transaction, and a receipt—plus cash if the operation involved withdrawal—would be provided automatically.

Finally, a pre-authorized debits arrangement could be used to pay recurrent bills. You would simply authorize the bank to debit your check account at specified intervals by specific amounts and to transfer these funds to other accounts. Such transactions are already being used in the areas of deductions for savings accounts and savings bonds, and payment of bills for insurance and loans. Again, no check would be written and a permanent record would be created.

The EFT arena is cluttered with problems ranging from financial regulatory issues to the impact that EFT systems will have on the consumer's lifestyle. Some possible EFT impacts are discussed in an Arthur D. Little, Inc., report.

The report points out that the high, middle and low socio-economic-status groups each have traditional and different patterns of handling income checks, using bank accounts, and methods of making payments. For those consumers who don't regularly use bank accounts or pre-authorized payments, EFT systems may pose some major problems in lifestyle adjustment. At the same time, EFT systems may be a boon for those consumers who are already making extensive use of bank and credit cards, pre-authorized payments and direct deposit of income checks.

What appears to be a telephone is actually much more. It is also a computer terminal located in a small branch office of a large metropolitan bank. By dialling certain codes, the teller can connect directly with the bank's main computer to get information on balances, deposits, and withdrawals. Incidentally, the computer answers the coded requests in English.

Some people are significantly concerned about the impact that EFT systems may have on the privacy of individuals. For example, the A.D. Little report states that the government, acting for accepted social purposes such as detecting tax evasion and improper claims of welfare payments, might seek access to electronic payment records. The ease with which EFT systems can collect, store and aggregate data may make the individual more vulnerable to invasion of financial privacy than current payment methods.

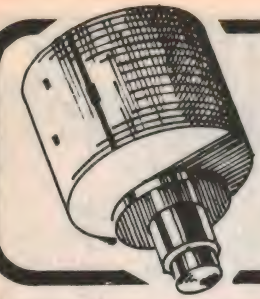
Welfare rights advocates fear that compulsory deposits of welfare checks, coupled with requirements for certain pre-authorized payments and other EFT records, could be used to regulate how welfare recipients spend their payments.

Finally, aside from the individual privacy issue, there is considerable concern about the security of EFT systems. Some authorities have already warned that EFT systems may offer the criminal element a new technique for counterfeiting or stealing money. We already know, for example, that our computer systems are not secure; Steve Lipner, MITRE Corporation, has reported that a recent study of financial fraud using computers shows that for about 300 cases the average loss was nearly $500,000 each. In order to protect electronic funds, it is clear that great emphasis will have to be placed on methods for positively identifying people trying to access EFT systems, and on techniques for protecting data in storage in computer systems or being electronically transmitted between computer systems.

The computer security program at NBS is a major source of standards, guidelines and techniques for protecting computer systems and networks and controlling access to them, and for safeguarding sensitive data. The Bureau's work in the areas of data encryption algorithms and such personal identification techniques as fingerprints and voiceprints certainly has application to the EFT security problem.

While it is interesting to speculate about the merits of electronic point-of-sale terminals, automated supermarket checkstands and electronic fund transfer systems, this speculation must be tempered with a liberal amount of cold reality. Because we have never before tried to bring the consumer into such close contact with the computer on a broad scale, we don't know the extent to which we may be fomenting a hot confrontation. There are many complex regulatory, technological, economic, and societal problems yet to be resolved in the EFT area alone. These problems are not likely to be solved quickly; it may be another 1½ years before the National Commission on Electronic Fund Transfer will report its findings to the Congress.

One point is certain—both the businessman and the technologist will develop new insights as they design and use the new breed of computer systems that interact directly with the consumer. In turn, the consumer may find new ways to make his presence felt in the board rooms and laboratories where decisions are made regarding the use of technology. If the businessman and the technologist learn to work intelligently with the consumer, they might find the consumer opening the door to the backroom the next time a computer system is ready to move to the front lines.



News Highlights

Mobile ultrasonic system tests railway track

Electronic equipment developed in Western Australia for testing railway track is winning export orders.

The company to develop the system, Ultrasound Technical Services Pty Ltd of 110 Jersey Street, in the Perth suburb of Wembley, recently exported to South Africa two fully-equipped rail testing cars worth a total of $500,000.

These vehicles house an ultrasonic testing device and computerised recording equipment to identify defects which develop in railway track during use. The ultrasonic transducer is carried beneath the car in an aluminium frame which may be adjusted to fit three gauges—standard, 5ft 2in and 3ft 6in. The cars have retractable railway wheels so they may be driven on and off a railway at will, thus ensuring a minimum loss of testing time.

A testing car currently in use in the Pilbara checks the 425 kilometre Mt. Newman to Port Hedland railway every three weeks and has found many defects which could have led to derailments had they not been corrected.

One of the firm's principals, Mr Mike Withey, said the firm had been drawn to railway inspection because of their location in Port Hedland, where they were originally employed in X-ray inspection of welds.

A close-up of the underside of the vehicle, showing the mounting points for the ultrasonic transducers.

Their first mobile testing unit was a small rail trolley that was pushed by hand—hot work in the Pilbara. A motor was added, allowing track inspection at about 5 kilometres per hour. Then followed a converted Kombi which travelled at 15-20kph while the operator kept his eyes on an oscilloscope for warning of a defect.

After receiving a commission from the Mt. Newman Mining Company, a long wheelbase Landrover was converted to be able to test track at up to 30kph and this vehicle is still in use.

Mr. Withey said the new cars could operate at up to 45kph under ideal conditions and the company had set itself a target of 60kph for future development.

The ultrasonic signal, which travels in a straight line through solid steel, is reflected by any defect in its path, be it a faulty weld, an inherent defect in the track, or a transverse defect caused by wear on the head of the rail. Reflected pulses in excess of a predetermined threshold are transmitted via a floor detector unit in the car to a computer system which gives a teletype printout showing the exact location of the trouble spot, the size and the type of defect.

A spray paint gun automatically marks the affected track and an alarm is sounded to alert the operator.

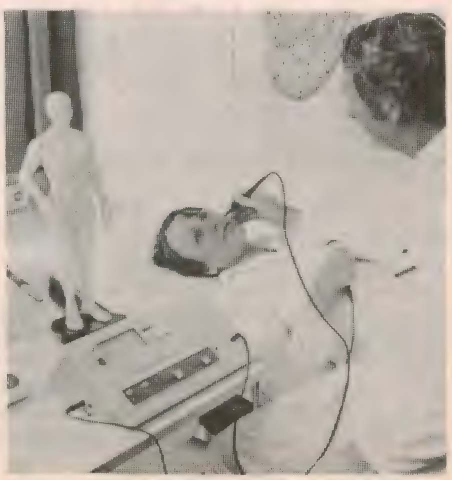
If the recorded data indicates a major defect the operator stops the vehicle and confirms the fault with manual testing equipment. He may have to put out an emergency radio call to stop traffic until the line has been repaired.

Low-power medical laser for painless acupuncture

Although the art of acupuncture has been practised in China for centuries, it is only in recent years that Western scientists have begun to take it seriously. Increasing acceptance in the West has meant the introduction of modern technology to overcome the disadvantages of traditional methods, and a German company, Messerschmitt-Bolkow-Blohm, has developed an acupuncture laser, the akupLas PL. The unit is available in Australia.

Reduced to essentials, the acupuncture laser consists of a low power (2mW) continuous wave gas laser emitting in the red range of the spectrum. Radiation wavelength is approximately 0.6um, and this is capable of penetrating tissue to a depth of 3-10mm, depending on the condition of the epidermis.

The laser output can be applied either as a continuous wave, or in the form of pulses, the frequency of which can be continuously adjusted within a "biologically reasonable range" (0.2Hz-5kHz).



A flexible sheathed light conductor is used to carry the laser radiation to the point of application. The end of this conductor is provided with a handpiece, and radiation is applied to the desired spot simply by placing the handpiece directly on the skin. The handpiece also contains a test electrode for measuring local skin resistance. This electrode is connected to the control panel, which provides a socket connection for standard skin resistance measuring devices.

The acupuncture laser is said to offer several advantages over the traditional metal needle method. These include: no pain felt by the patient during treatment; the skin is neither injured nor damaged, eliminating the risk of infection; the unit is simple to use; and short duration therapy is possible. The akupLas PL can be used in all cases that can be treated with conventional acupuncture, according to the manufacturers.

Enquiries to PCP Instrumentation, 231-233 Victoria Rd, Rydalmere, NSW 2116. Telephone (02) 638 6400.

Telephone aids for the handicapped

Patients in a Yorkshire hospital are helping the British Post Office develop new telephone aids for handicapped people. During their visits to Pinderfields Hospital in Wakefield – which has an aids demonstration centre – the patients have been trying out new designs produced by the Post Office in its constant search for ways of helping disabled people use telephones more easily.

These trials are part of a program to assess aids for daily living being organised by the Department of Health and Social Security. They are being conducted jointly by the Post Office's Human Factors Section and the Hospital's Occupational Therapy Department.

One aid currently being tested at Pinderfields is a telephone dial with a handle attached to it to help a user overcome extreme dialling difficulty. Some disabled and elderly people might welcome a dialling-stick which allows more leverage for those with weak hand-grip. Others might prefer bigger finger-holes on a slightly larger dial.

Another device is for inserting coins in telephone-boxes. People who cannot cope with the conventional slot can instead push their money into a groove and simply pull a handle to make the coins drop into the box.

The new Keyphone, with its numbered push-buttons replacing the more familiar dial, can also be adapted for people suffering from hand-tremor. A plastic frame is placed on top of the numbers, its ribs separating the adjacent buttons to make sure only the right ones are pressed.

These are just some of the aids tested at the hospital. Some or all of them could be offered in the near future, adding to the list of numerous aids the Post Office already supplies.

Luxor colour TV, hifi

OBC (Imports) Pty Ltd, Australian distributors for Luxor electronic products, concentrated their 1976 efforts to establish the product name in Australia mainly around colour television receivers. These are now well known in retail stores throughout the country.

In the current year, attention is tending to shift more to the hifi/stereo area with something like twenty-five new product lines being announced progressively in the first quarter, including loudspeaker systems, cassette decks, record players and complete stereo systems.

According to Managing Director J. M. Hart, a special publicity campaign is planned for 1977 and, at the time of writing, negotiations are in progress to engage the services of a major overseas personality.

A new warehouse, assembly plant and service centre is currently being built in Clayton, Victoria for OBC (Imports) Pty Ltd.

New electronic components store

A new electronic components store, Davred Electronics Pty Ltd, recently commenced operation in NSW.

Davred Electronics is an offshoot of the parent company David J. Reid (NZ) Pty Ltd, first established in New Zealand more than 25 years ago. The firm originally operated as an electronic importing company servicing NZ manufacturers but, ten years ago, expanded its operations to include the total NZ electronic market by setting up a nationwide distribution and sales network.

The company now claims to be the largest electronic components company in NZ, with sales turnover now running into millions of dollars each year. The company presently has 5 manufacturing plants, 9 branches nationwide, and employs over 300 people.

In Australia, Davred Electronics are retailing a wide range of equipment, including kitsets, semiconductors, TV aerials, tools, speakers, components, panel meters and metric nuts and bolts.

David J Reid's New Zealand headquarters.

Goods are available either over the counter of their Newtown (Sydney) store, or by mail order.

The Australian operation is headed up by Mr Des Bain, who has had many years of experience in the electronics industry. The store address is 104-106 King St, Newtown, Sydney; mail orders to PO Box 317, Newtown, NSW 2042. Telephone 519-6361.

British mobile radar has two-in-one aerial

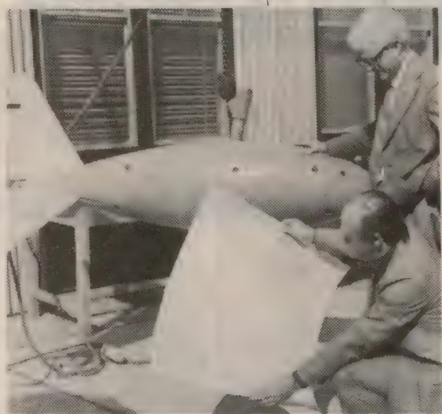
The aerial of a long-range three-dimensional radar installation stands starkly against an evening sky in southern England. Part of a mobile air surveillance system, this type of aerial is the first to be designed with the height-finding element built into the array and rotating with it.

The system, the AR-3D, is able to gather range, elevation and azimuth information and does not require a separate secondary antenna. It is manufactured by Britain's Plessey company, a leading producer of radar equipment and creator of the Doppler Microwave Landing System (MLS) at present being evaluated by the International Civil Aviation Organisation (ICAO).

This new store, recently opened by Altronics at 105 Stirling St., Perth, is a full scale Dick Smith dealership store. The store carries the full range of stock that has made Dick Smith stores so popular, and features a modern layout. Self-serve invoices are provided for busy lunch-time shoppers.

NEWS HIGHLIGHTS

Sonar "fish" to solve undersea mystery



This sonar 'fish'—seen here with its developers Professor Chesterman (standing) and Dr Roger Cloet of Bath University in south west England—can instantly recognise and record movement.

Developed to solve the mystery of the Brown Ridge—a large area of sea bed in the southern North Sea covering 2590 square kilometres—the two metre long 'fish' can map a range of 1100 metres at a time at speeds of 7½ knots, covering 15 square kilometres in an hour.

The Brown Ridge lies on the most direct route between England and Holland and Denmark. Because of its reputation for constantly changing its shape—believed to be caused by a phenomenon called sandwaves which move round the sea-bed like sand dunes in the desert—authorities responsible for laying telephone cables avoid it with lengthy and costly detours. They face two major risks by laying across it; the movement of the sea bed could either leave lengths of cable suspended, making them subject to enormous strain and vulnerable to trawling gear, or it could bury the cable so deep that it could not be located for servicing or repairs.

Apart from helping to solve the cable problem, the Bath researchers see other uses for the 'fish' in sea and sea bed research and in connection with marine engineering—especially with the growing industry of extracting oil from the sea.

Canada to increase CB channels to 40

Canada is to follow the lead of the US by raising the number of CB channels to 40. Official starting date for the new channels is April 1st, just three months after the US starting date.

The Canadian CB radio service uses the same frequency band (26.965–27.405MHz) as the US, and channel expansion was prompted by interference problems. Technical standards will reportedly take the same form as those of the FCC in the US. Applications for approval of new models were being accepted as from January 1st.

Frequency allocation planning for FM

As an essential first step to the systematic introduction of an Australia-wide FM service, the now-defunct Australian Broadcasting Control Board released a draft plan for frequency allocations in the part of the VHF band at present available for FM broadcasting.

In releasing the report, the Chairman, Mr. Myles F. E. Wright, drew attention to two important engineering matters. He pointed out that, since the acceptance by the Government of the McLean report in 1974, which involved the use of the VHF band for FM, the Board had been steadily planning the re-arrangement of those portions of the band for which it was responsible. However, no steps whatever had been taken to implement the remaining changes recommended by Sir Francis McLean, involving the movement out of the VHF band of some other services.

"The estimated time for making these changes is up to ten years". Mr. Wright said, "and if they are not put in train immediately, the development of FM broadcasting will simply come to a halt early in the 1980's. The Board has urged successive Ministers to start planning, but nothing has happened so far."

The report also emphasises interference difficulties which have arisen with Australian television receivers and some FM receivers which have been tested by the Board. The Chairman said that the Board hoped that the Standards Association of Australia would expedite the consideration being given to the development of draft standards not only for television receivers, but also for FM receivers.

THE CB SCENE: Govt. releases CB report

The long awaited discussion paper prepared by the Post and Telecommunications Department on citizen band (CB) radio was finally released in Canberra on January 25th last.

Announcing the release, the Minister for Post and Telecommunications, Mr Eric L. Robinson, said that the paper canvassed some of the issues surrounding the question of introducing a CB radio service in Australia. According to Mr Robinson, "this is a complex matter with many points of view existing in the community, not all of which are in favour of legalising CB radio".

The Minister said that the existence of the discussion paper in no way altered the current legal position under which unlicensed operators could be prosecuted and have their equipment seized. At the moment only a few nations had a legalised CB radio service, and their experiences made it imperative that the matter be given full deliberation.

The report itself draws no definite conclusions on the introduction of CB; nor does it make specific recommendations. The paper, by its own admission, examines the present policies relating to private two-way radio communication services in Australia, looks at the overseas CB experience, and compares the services available in Australia to those of the USA. It then goes on to comment "on the benefits and problems associated with a CB service and concludes with a number of options ranging from the retention of present limitations . . . through to the establishment of a 'USA-type' service."

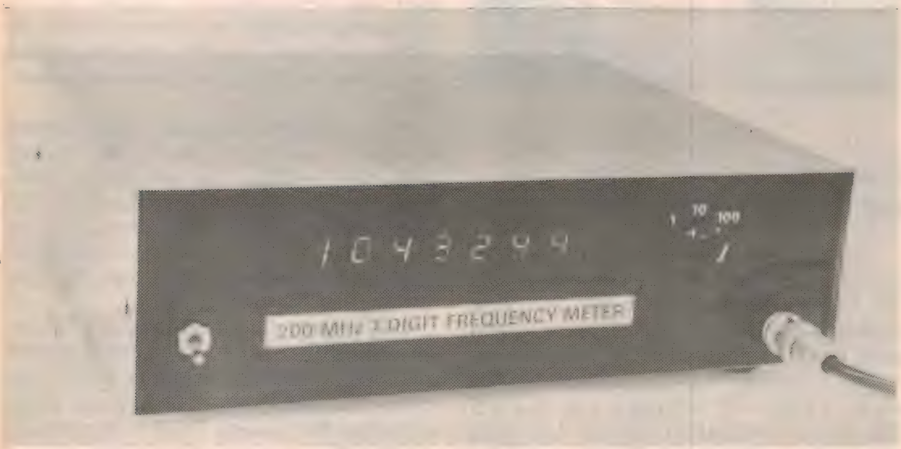
Among these various options is a proposal to establish a CB radio service in the UHF frequency band. As for the 27MHz band, it is stated that a CB service "could be introduced in this form provided that the equipment used conformed to the present USA technical standards, SSB mode of transmission was used, the service was genuinely restricted to mobile operation and channels other than those used in the USA were allocated".

The report also states that "action needs to be taken to control or ban the importation of obsolete USA 27MHz CB radios", but concedes that the "Australian administration would find it a difficult task to remove the illegal operators . . ."

On a more positive note, the paper notes that if a CB service is considered necessary, "it should be based on sound regulatory procedures and technical specifications." Again, the "introduction of a CB service could provide a significant stimulus to the Australian electronics industry, bring safety aspects to the community and expand the present hobby interest in radio."

A low-cost 200MHz digital frequency meter

. . . easily built unit is ideal for workshop and laboratory



With the recent release of several new CMOS integrated circuits in Australia, we have been able to produce a new high performance frequency meter with greatly simplified circuitry. Our latest design has seven digits and can measure up to 200MHz. It employs twelve integrated circuits and a handful of discrete components.

by LEO SIMPSON

Yet again, rapidly improving technology has enabled us to present a project which is considerably simpler and cheaper in real dollar terms than its predecessor. In 1970, we published a design for a 3½-digit 70MHz counter which employed a total of 43 IC's. That was superseded in December 1973 by a 4½-digit 200MHz design employing 24 IC s. And now with half that number of IC s, we present a 200MHz frequency meter with a seven-digit readout.

Apart from the seven-digit readout, almost every aspect of the new design is simpler than its 1973 predecessor. There are less controls, and assembly is more straightforward.

We hope the new styling will be popular too. The unit is housed in a low profile case measuring approximately 230 x 68 x 210mm (W x H x D). The front panel is made of red polaroid film which we assume suppliers will have screen-printed in white. When the unit is off, the front panel is dark and inscrutable, with no digits showing. When power is applied all digits are alight.

Brilliance of the readouts is quite high and adequate even in sunlit rooms, although readers might gain a different impression from the lead photo. Perhaps we should have had the photo retouched by an artist!

Some of the features of the new frequency meter are as follows: The range switch has only three positions—x1, x10 and x100. On the first range it will measure to above 3MHz. On the "x10" range measurements can be made to between 25 and 30MHz, depending on the input signal. And on the "x100" range measurements can be made to above 200MHz, again depending on the input signal amplitude.

The new design does not have leading zero blanking. While we regard LZB as a desirable feature, it was not possible to incorporate it in the present design.

No provision has been made for period counting or event counting under manual control. Nor is there any sensitivity adjustment. Measurements are restricted to a single low rate of one every two seconds, to keep the timebase circuitry simple and to eliminate timebase switching.

Input impedance of the meter on the "x1" and "x10" ranges is 1 megohm shunted by about 50pF. Sensitivity is about 50mV RMS or better from 10Hz to about 10MHz. On the "x100" range, the input impedance is 75 ohms or more and input sensitivity is 200mV RMS up to about 180MHz. A signal of 800mV P-P is required to guarantee operation to 220MHz and above. Minimum input frequency on the "x100" range is 1MHz.

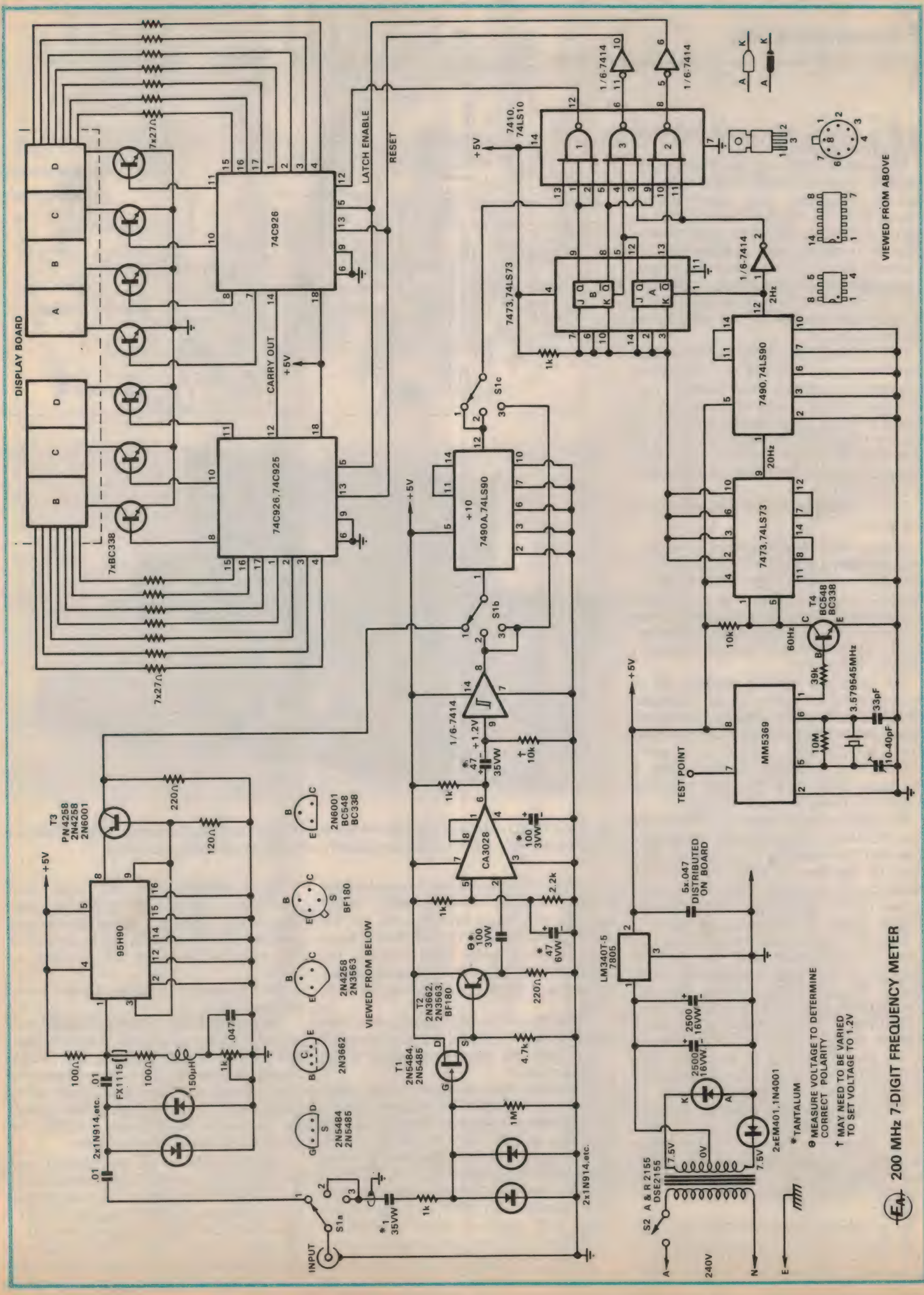
Accuracy of the frequency meter will depend on the accuracy and stability of the crystal timebase. This can be expected to be within a few parts in 100,000. Resolution is 1Hz on the "x1" range, 10Hz on the "x10" range and 100Hz on the "x100" range.

Power consumption is fairly modest. Current drain is about 500 milliamps from the regulated 5V supply. The unit is normally powered from the 240VAC mains, but provision has been made on the PCB to power the unit from a 12V car battery via an isolating diode.

Our estimated cost for the unit is less than $120. When you consider that the 1973 design was worth about $140 and the extent of inflation since then, the projected cost for a kit of parts is a bargain in real dollar terms. And the nearest comparable frequency meter retails for many hundreds of dollars more!

Heart of the design is a pair of 74C926 CMOS 4-decade counters. These have been recently released by NS Electronics Pty Ltd.

Like many multi-function integrated circuits these days, the internal complexity is so great that the manufacturers do not bother to publish a schematic. The 74C926 contains virtually all the circuitry needed, apart from the timebase and



200 MHz 7-DIGIT FREQUENCY METER

Frequency meter

display drivers, to make a four-digit frequency counter.

Contained in the chip are four decade counters (same function as the 7490 TTL decade counter), four 4-bit latches (equivalent to 16 flip-flops), BCD to seven segment decoders and drivers, plus an oscillator and multiplexing circuitry for the four digit driver transistors. Thus, even if the multiplexed output feature is not taken into account, the 74C926 is equivalent to eight IC s as used in our previous design.

It is appropriate to note at this stage that there are a number of competitive counter IC s, notably from Mostek, Ferranti and Intersil. Some of these may be better in some respects than the 74C926 but we regarded the National device as the best all round choice, especially when price, availability and compatibility is considered.

More about the 74C926 device later in the article.

Most of the timebase circuitry is contained within a single MOS integrated circuit, the MM5369N. This is described by National Semiconductors as a 17-stage programmable oscillator/divider. It can be programmed during manufacture to divide by a selected number between 10,000 and 98,000.

The particular device used by us is programmed to work with an American standard colour TV subcarrier crystal operating at 3.579545MHz. Output from the 5369 is 60Hz. This is a very economical method of obtaining a timebase since both the 5369 and the 3.58MHz crystal are quite cheap.

The 60Hz output from the 5369 is fed to a BC548 transistor to make it compatible with the following TTL stages. A 7473 dual JK flip-flop is interconnected to divide by three, to give 20Hz. This signal is then further divided by a 7490 decade divider to give a 2 Hertz square wave.

The 2Hz output from the timebase circuitry is interfaced with the 74C926 counters in what logic designers quaintly term a "housekeeping" circuit. The circuit consists of a 7473 dual JK flip-flop, a 7410 triple 3-input NAND gate and 3 Schmitt triggers in a 7414 hex trigger which are employed as inverters. The housekeeping circuit configuration is similar to that in our previous design.

Three different pulse trains are derived from the 2Hz timebase by the housekeeping circuitry, to control the 74C926s: One second pulses for gating and 250mS pulses for "reset" and "latch enable". Let us explain the term "latch enable".

As noted above, each 74C926 has four 4-bit latches. These are equivalent to a chain of flip-flops which are used to store the BCD count of the four decade counters. The latch information is used to drive the LED displays. Early frequency counters did not have latches and so the display was rapidly cycled during each count period. With latch circuitry the readout is constant if the input frequency is constant—there is no blinking or flickering.

So the "latch enable" pulse is the command to the 74C926 to transfer the BCD count from the decade counters to the 4-bit latches.

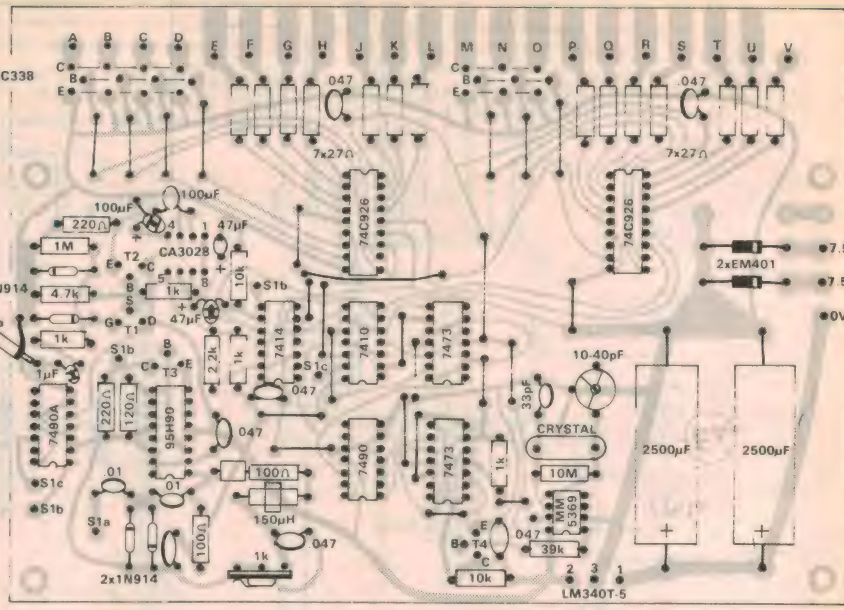
The basic measurement cycle takes two seconds. In the first second, gate 1 of the 7410 is turned on by the second flip-flop in the 7473 to allow a one second burst of input signal to be fed to the clock input (pin 12) of the first 74C926. The first 74C926 counts the first four decades (to 9999) and generates "carry out" pulses to allow the second 74C926 to count the following decades.

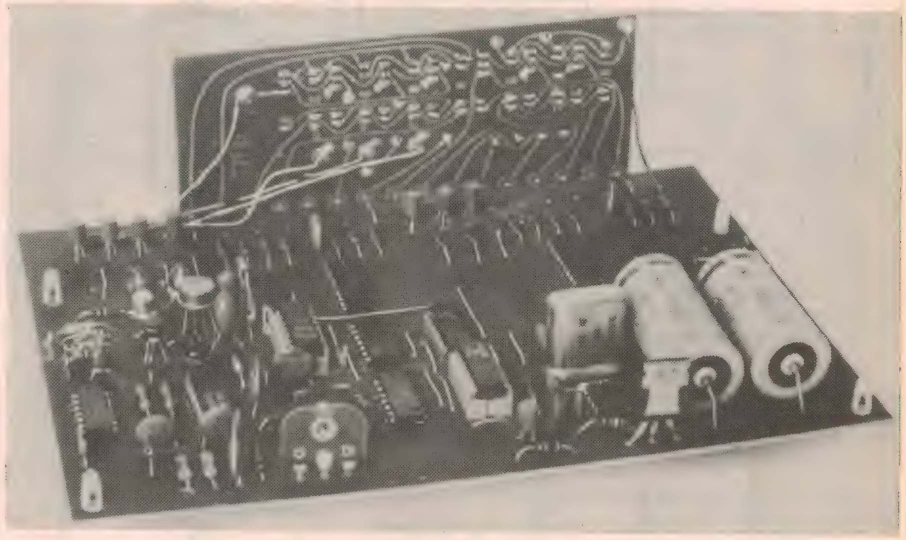
During the third half-second of the 2-second measurement period a 250mS pulse is delivered to pins 5 of both 74C926s to transfer the BCD count into the latches. Then in the last half-second another 250mS pulse is fed to pins 13 of the 74C926s to reset the counters to zero.

So the display is updated once every two seconds.

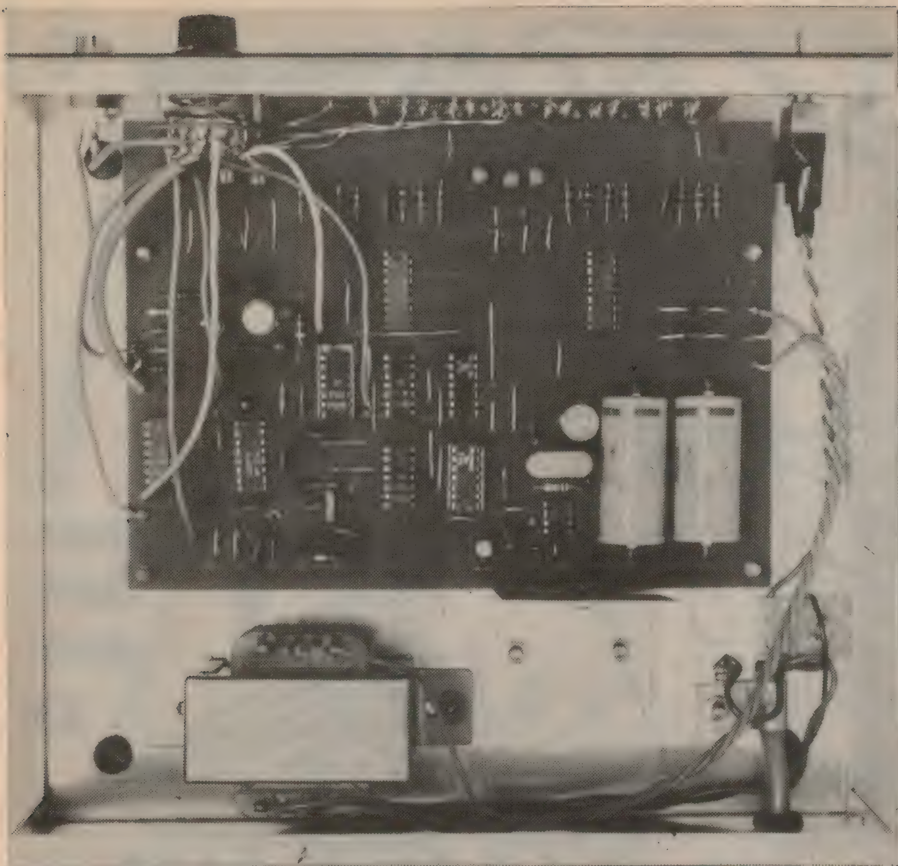
Notice that the second 74C926 only drives 3 digits instead of 4. We have omitted the fourth digit, because the 74C926 typical maximum count rate of between 3 and 4MHz plus the one second gating time mean the maximum count cannot go beyond 4,000,000—well within the capacity of seven display digits.

The front end of the new design consists of a FET, an NPN emitter-follower, a CA3028 RF amplifier and one section of the 7414 hex Schmitt trigger. The FET provides an input impedance of 1 megohm. The NPN emitter-follower combines with the FET to provide a very low source impedance to drive the

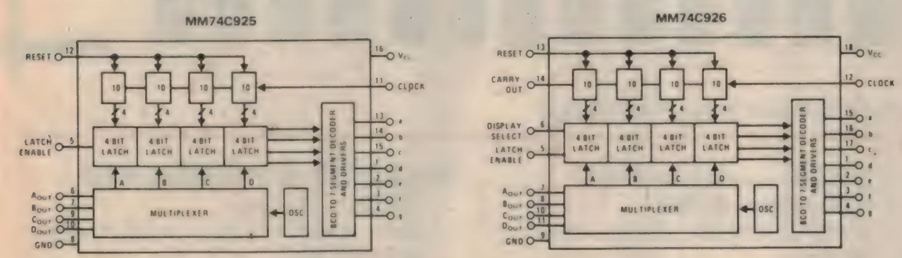




At top is the component layout for the main PC board. Above shows the completed board assembly with the display board soldered in position and wired.



Notice that the heatsink for the regulator IC is bolted to the chassis.



Logic diagrams for the MM74C925 and MM74C926 four-decade counters.

CA3028 RF amplifier. The latter makes up for the signal loss in the FET source-follower and NPN emitter-follower and provides the extra gain to allow the signal to toggle the Schmitt trigger.

On the "x10" range the signal from the 7414 Schmitt trigger (pin 8) is fed via a high speed 7490 or 74LS90 decade divider. These decade dividers have a maximum toggle rate of 40MHz so the maximum frequency limitation on the "x10" range is set by the 7414.

On the "x100" range the input signal is fed to the 95H90 prescaler and thence to the 7490A/74LS90 decade divider to give a resultant division of one hundred. The 95H90 prescaler is very similar to that in the previous 1973 design except that the bias circuitry has been slightly modified to improve the sensitivity.

The power supply is simple. A 15V centre tapped secondary transformer drives a full wave rectifier and two 2500uF capacitors in parallel. A three-terminal plastic pack regulator then derives the 5V rail.

All of the circuitry, apart from the input switching and the seven segment readouts, is mounted on a single PC board measuring 178 x 127mm and coded 77F1a. The seven segment readouts are accommodated on a separate PC board measuring 118 x 55mm and coded 77F1b. This board is mounted and secured at right angles to the main board.

Take care when making solder joints to avoid damaging the PCB. Use a low wattage soldering iron with a small chisel-shaped bit. Mount all the wire links first. Then mount the discrete components and PC pins. Leave the 5369 and 74C926 ICs until last. Note that all the ICs with the exception of the 74C926s are oriented in one direction—with notched ends towards the rear of the PCB.

We have not found it necessary to take any special precautions when soldering the CMOS ICs except to use a small low voltage iron. If you are worried, connect the soldering iron to the PCB earth pattern with a jumper lead and then solder the supply and earth pins of the CMOS ICs first.

Notes about some of the components are appropriate here. Polarity of the 1uF input tantalum capacitor is unimportant. The NPN emitter-follower must be a transistor with a very high value of gain-bandwidth product (Ft), otherwise the output impedance will increase at high frequencies and thus reduce the gain of the CA3028.

The CA3028 may be supplied in a circular can or an 8-lead minidip package. If a circular type, the leads will have to be bent to suit the copper pattern. (Experimenters who may wish to use the CA3028 as a preamp in other circuits because of its very wide bandwidth should note that because of the low supply voltage and cascode connection it does not have a linear transfer characteristic. That is immaterial in this circuit.)

Two of the Schmitt triggers in the 7414 are unused. Their inputs (pins 3 and 13) are grounded and outputs (pins 4 and 12) have no connection. The 10k resistor from pin 9 of the 7414 may have to be shunted down with higher value resistors. This to bring the input voltage down to around 1.2V which is between the positive and negative thresholds of the device. This maximises the sensitivity of the circuit.

Low power Schottky ICs may be substituted for TTL ICs if available. This has the advantage of lowering the power consumption. The devices in question are 74LS10, 74LS14, 74LS73 and 74LS90.

A 74C925 may be substituted for the 74C926 which drives the three most significant digits. A 74C925 is identical to a 74C926 except that it does not have a carry output to enable cascading.

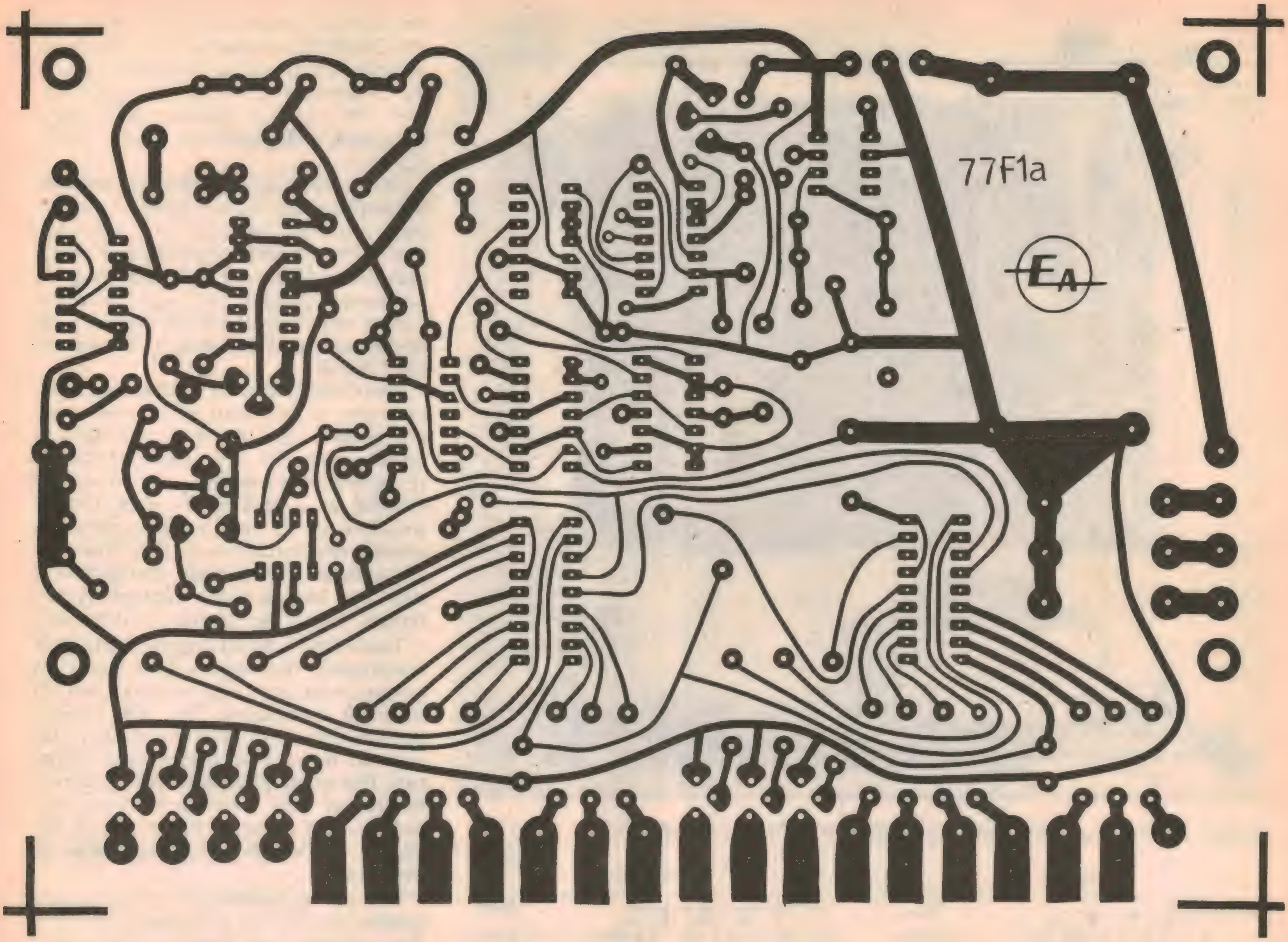
We have specified BC338 (or BC337) for the digit drivers because of their low collector saturation voltage. It is possible to substitute BC548 but the readouts will not be as bright and there is also the likelihood that they will not all have the same brightness.

Pin 7 of the MM5369N is a buffered output for the 3.5MHz oscillator. However it is of no real use in calibration. It could be handy for troubleshooting to check that the oscillator is actually running.

The 2N4258 transistor following the 95H90 is a very high speed switching type. Do not subtitute types other than those suggested, unless they are known to be suitable for high speed operation.

The readout PCB is easy to assemble. Solder in all the wire links first. This is necessary because some run underneath and between the LED displays. Any common cathode LED display such as Monsanto MAN-7 or Litronix DL-704 may be used.

The readout PCB is attached to the



The PC pattern for the main board, reproduced actual size to facilitate tracing.

PARTS LIST

MAIN PCB ASSEMBLY

1 PCB, 77F1a, 178 x 127mm
1 3.58MHz crystal
11 PC pins
1 150uH RF choke
1 FX115 ferrite bead

SEMICONDUCTORS
2 74C926 4-digit counters
1 95H90 ECL prescaler
1 CA3028 RF cascode/differential amplifier
1 MM5369N oscillator/divider
1 74LS90 or 7490A high-speed decade counter
1 7490 decade counter
2 7473 dual JK flip-flop
1 7414 hex Schmitt trigger
1 7410 3-input NAND gate
1 7805 or LM340T/5 5V/1A regulator
7 BC338 NPN switching transistors
1 BC548 NPN transistor
1 PN4258, 2N4258, 2N6001 PNP high speed switching transistor
1 2N3563, 2N3662, BF180 NPN RF transistor
1 2N5484 or similar VHF FET
4 1N914 signal diodes
2 1N4001, EM401 silicon rectifier diodes

CAPACITORS
2 2500uF/16VW electrolytic
2 100uF/3VW tantalum electrolytic
2 47uF/6VW tantalum electrolytic
1 1uF/35VW tantalum electrolytic
6 .047uF 25VW ceramic
2 .01uF/25VW ceramic
1 33pF NPO ceramic
1 10-40pF ceramic trimmer (Stetna)

RESISTORS
(¼ or ½W, 10% tolerance)
1 x 10M, 1 x 1M, 1 x 39k, 2 x 10k, 1 x 4.7k, 1 x 2.2k, 4 x 1k, 2 x 220 ohms, 1 x 120 ohms, 2 x 100 ohms, 14 x 27 ohms, 1 x 1k trimpot.

READOUT PCB ASSEMBLY

1 PC board, 77F1b, 118 x 55mm
7 seven-segment common cathode LED display, Monsanto MAN-7, Litronix DL-704 or equivalent
Tinned copper wire for links.

CHASSIS & HARDWARE

1 chassis and cover
1 front panel (screen-printed red polaroid film).
1 BNC socket, single-hole mounting
1 knob
1 SPST miniature toggle switch
1 4 pole three-position switch
1 power transformer, 15V centre-tapped at 1 amp DC; A&R 2155, DSE 2155
1 aluminium heatsink to suit IC regulator
4 rubber feet
4 Richco 10mm high PCB supports
1 solder lug
1 three-pin mains plug and three-core flex
1 mains cord clamp and grommet
1 three-way insulated terminal block

Miscellaneous: screws, nuts, lock-washers, short length of shielded cable, hook-up wire, tinned copper wire, insulation tape, solder, etc.
Note: Capacitors and resistors with higher ratings may be used if physically compatible. Other substitutions, unless mentioned in the text, are not recommended.

main PCB by soldering the line of pads together on both. There is a line of holes along the bottom edge of the readout PCB. These should be lined up with the top surface of the main PCB by means of a couple of wire links running between the boards. Set the boards at right angles, and run a fillet of solder between each set of matching pads on the boards. One of the photographs illustrates the method.

This makes the majority of connections to the display PCB. There are five wires left to be run to the display PCB from the main PCB. This completes the PCB assembly.

Now assemble the chassis hardware. Solder the mains leads to the power transformer, tape them and bolt the transformer to the chassis. Mount the heatsink for the regulator. The heatsink should be made of aluminium, say 20 SWG. The dimensions are 45 x 85mm bent 30mm from one end.

The screen printed Polaroid panel should be attached to the chassis with a suitable adhesive or double-sided adhesive tape, along with the two switches and input socket.

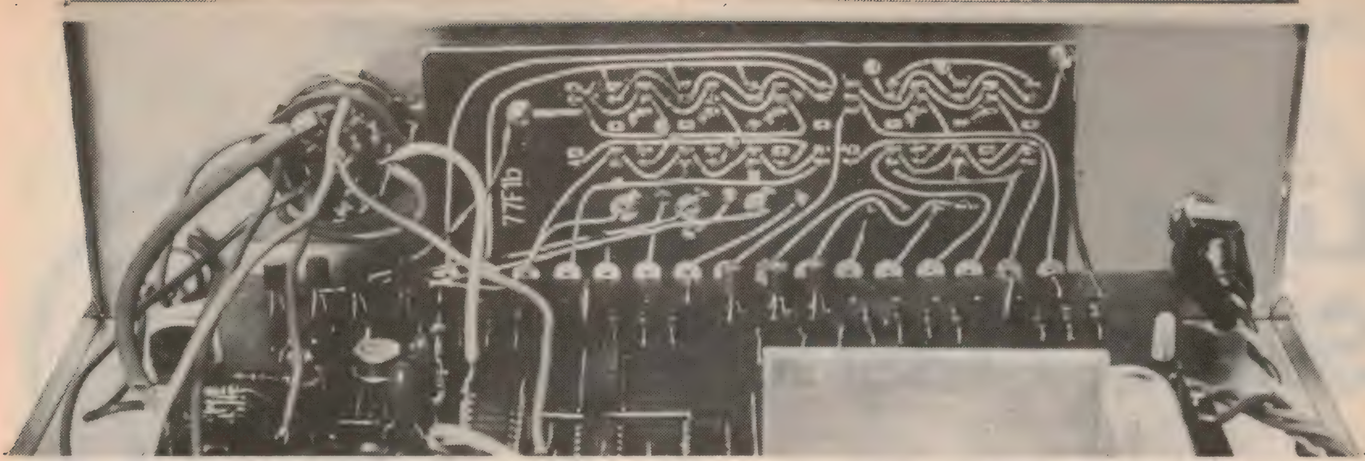
If you are unable to obtain a screen printed Polaroid front panel from kitset suppliers, red Polaroid film can be purchased from the Customer Service Division of Polaroid Australia Pty Ltd, 2 Smail St, Ultimo, Sydney, NSW. The cost is 10 cents per square inch which adds up to $2.25 for a panel. Labelling may be added with white Letraset.

The input socket may be a single hole mounting BNC type or a single hole mounting UHF type to take a PL259 connector. The mounting hole needs to be larger for the latter type. Do not earth the socket directly to the chassis.

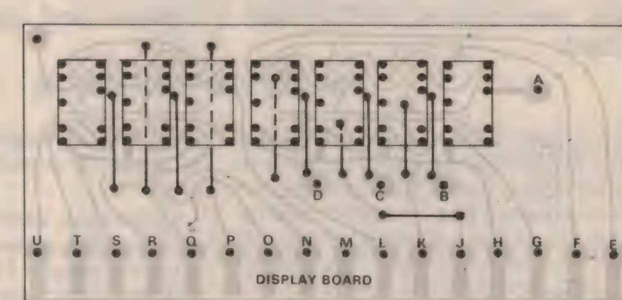
The three-core mains cord should be passed through a grommetted hole in the rear of the chassis and anchored with a cord clamp. Terminate the earth wire to a solder lug on the chassis. Terminate the active and neutral conductors plus the wires to the transformer primary and the mains switch to a three-way insulated terminal block.

Loosen the clicker plate of the input switch before installing it so that it can be easily operated with a small knob. Also cut the shaft to length before installation.

With chassis assembly complete, fit Richco supports to the PCB and mount it in the chassis. Alternatively, use screws and nuts to support the PCB 10mm off the chassis. Attach the regulator to its heatsink and run the wires to the input switch. Run the wires as shown in the photo. Do not attempt to lace the wiring into a neat cable form or run the wires close together, as this will cause faulty



A close-up view of the wiring behind the front panel. Note that the short length of shielded cable from the range switch is earthed only at the PC board, and not at the switch itself. Tape the mains switch to avoid the possibility of shock.



Photograph at left illustrates how the display PC board is soldered to the main PC board. Above is the component overlay pattern for the display board.

operation. Note the short length of shielded cable from the input switch, which should not be omitted.

Check wiring and apply power, then quickly check the 5V rail to make sure that all is well. The LEDS should show zeros, except for the least significant digit which may show "1". The 10k resistor associated with the 7414 should be adjusted as noted above. If too low a value is used it may prejudice the sensitivity and may result in random readings on the least significant digit.

Now adjust the 1k pot for optimum sensitivity of the 95H90 prescaler. Feed in a VHF signal at 100MHz or higher and adjust the pot until a stable reading can be obtained with the smallest input signal. With too small a signal the reading will drop from its correct value and vary randomly—or it may drop to zero. With optimum sensitivity the 95H90 becomes sensitive to random noise and will show a random reading on the last three digits with no signal applied.

When the pot has been adjusted for maximum sensitivity the 95H90 will run quite warm to the touch. This is normal.

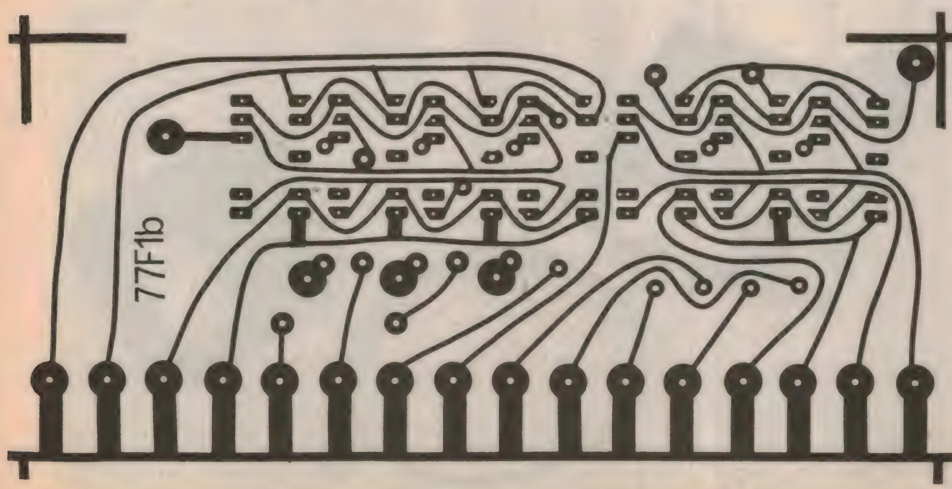
Calibration presents a problem. However without calibration the unit will have a typical accuracy of .01% ±1 count, which should be adequate for most applications. The easiest method is to calibrate the meter by making comparison measurements with a frequency counter of known accuracy. That is how we did it.

There are two other methods, neither of which we have tried. One is to use a crystal set tuned to a strong broadcast station and measure the signal when there is no modulation. This may be difficult and selectivity may present problems, but it could be worth trying.

The other method is to use a signal generator and a broadcast or short-wave receiver. Set the generator for zero beat against a station of known frequency (and precision). Then measure the output of the signal generator.

For the best result, the calibration should be carried out only after the counter has been on for an hour or so, to stablise its temperature. If the receiver is fitted with an "S" meter, this can be used to get closer to the true zero beat condition than if the audio output is used alone. The idea is to try and get the needle of the meter swinging as slowly as possible.

A brief note about using the frequency meter. A signal too high in frequency or insufficient in amplitude may result in a false reading or zero. The tip off is to watch the 2nd and 3rd most significant digits. If these vary, it is miscounting.



Here is an actual size reproduction of the display board pattern.

Simple unit is ideal for amateurs and professionals

Light Trigger for Slave Flashguns

Keen photographers will appreciate this simple slave flash trigger, which uses only a LASCR and a resistor and can be easily constructed.

by DAVID EDWARDS

Any reader who is keen on photography will already be aware of the uses to which a slave flash can be put. So apart from mentioning that it is often used for lighting the picture subject from the side or from above by a ceiling "bounce" to get a diffused effect, we will leave it at that.

The basic concept of a slave flash trigger is to have the slave flash actuated by the light "burst" from the main flash which is controlled by the camera contacts. To do this, the trigger circuit must use a light-activated device.

To understand the function of the slave trigger flash unit, which really substitutes for the camera contacts, one must be

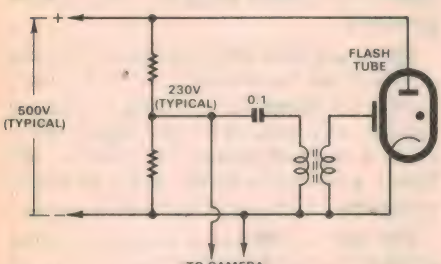


FIG. 1

A typical electronic flash circuit. Some use an SCR to discharge the capacitor, but the basic arrangement is the same.

familiar with the circuit of a typical electronic flashgun. While these vary greatly in detail, they all use a transistor converter which changes the 3 to 12V battery voltage up to between 350 and 500V DC.

A typical electronic flash firing circuit is shown in Fig. 1.

A pulse transformer is used to fire the flash tube and this is energised in much the same way as the coil in an automotive capacitor-discharge ignition system. In the flash-gun though, the trigger capacitor is typically about 0.1uF. It is charged via the high resistance voltage divider and then discharged by the camera contacts via the primary of the pulse transformer.

In previous articles for slave flash triggers, we have never been able to present a circuit using a LASCR (light activated SCR) only, because suitable LASCRs have not been available. But Mr A. Browne, of South Hurstville NSW has recently brought to our attention the availability of suitable devices, and suggested the circuit presented with this article.

1 amp 400 PRV (peak reverse voltage) LASCRs are now available from Tandy stores. Current price is $2.95, and the catalogue number is 276-9004. These devices, with the addition of a suitable gate resistor, are quite suitable for triggering flash units.

Fig. 2 shows the circuit, and as you can see, it is very simple. In fact, the most difficult part of the project is finding a suitable way of mounting the LASCR, and connecting it to the flash unit.

Before commencing construction, it is wise to first check the polarity of the voltage which the flashgun applies to its trigger terminals. In all the examples we have checked, the centre lead was positive, although this is by no means certain to be the case with all flash units.

Turn on the flashgun and measure the voltage and polarity across the socket using a multimeter switched to a high DC voltage range. Do not be surprised if the voltage is below 200V or conclude that use of a 200V LASCR is permissible.

The apparently low voltage across the flashgun connector will be due to the loading effect of the meter. For example, a VTVM with a load resistance of 10M or a 20,000 ohm per volt meter on the 500V range (which results in a load of 10M) will reduce the voltage across typical flashgun connectors by 30 or 40 volts.

Having made a note of the measured polarity, construction can commence. The general scheme that we used can be seen in the photographs. The LASCR and gate resistor were simply soldered directly to the end of the cable, and protected by a plastic cover.

The completed trigger, shown with some typical flash units.

The cable was obtained from a photographic supply centre, and is simply half of an extension flash cable. This has a male connector on one end, and the corresponding female connector on the other end. We will use the end with the female connector, as this is the end which will mate with the flash gun.

The plastic cover for the LASCR and resistor was the discarded cover from an RCA phono plug. Other possibilities include the use of heatshrink plastic, or alternatively, the unit could be potted in plastic.

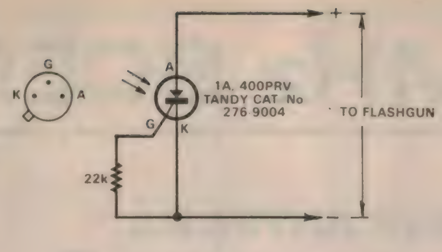
The cover must be fitted to the cable before the LASCR and gate resistor are soldered to it. Cut the gate lead of the LASCR off close to the device body, and solder the gate resistor to the stub of the lead. Insulate the cathode lead with a short piece of plastic tubing (hook-up wire insulation is ideal), and solder it to the free end of the gate resistor.

Strip the end of the cable, and tin the ends. The centre lead (if it is the positive lead) is soldered to the anode lead, and the outer lead is soldered to the cathode lead. The anode lead should be insulated in the same manner as the cathode lead. Construction is completed by pushing the plastic cover over the completed assembly.

To test, connect the unit to a flashgun, and check that normal room light does not cause the flash to fire. Then activate the main flash, and check that the slave fires also. It may be necessary to point the LASCR at either the main flash, or at the subject background. We found that reliable triggering could be obtained when the LASCR was looking at a blank wall, and seeing the main flash "reflection".

We have tried the slave trigger out with a number of different flashguns, particularly the cheaper types which we felt most readers would be using. Operation with these types was very good.

However, when we tried the trigger on more expensive "professional" type flashguns, we found that with some the operation was unreliable. It appears many of these guns use an SCR in the firing circuit to protect camera contacts (mainly because they are likely to be used much more frequently). Instead of the contacts having to handle the firing capacitor discharge current of an amp or more, they pass only the SCR gate current—milliamps.



LASCR FLASH TRIGGER

FIG. 2 3/EF/

The circuit shows the simplicity of the slave trigger—just two components.

The two components are soldered directly to one end of the cable.

PARTS LIST

1 1A 400PRV LASCR (Tandy Cat. No. 276-9004)
1 22k ¼W resistor
1 flashgun connector cable
1 plastic RCA phono plug cover
NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with high ratings may generally be used provided they are physically compatible.

Because the current available through the sync contacts of these units is so low, the LASCR in the slave trigger is not able to turn on properly. Therefore, the slave may not fire.

The easiest way to cure this is to place a 0.1uF capacitor directly across the LASCR (anode to cathode). This creates an artificial reservoir which makes sure the LASCR can fire when required. Note that this capacitor must be rated at 300V or more.

There is no need to make this modification if you do not intend to use a flash with SCR triggering. As most flashguns are not in this category, the modification is not shown on the circuit diagram.

THE 27MHz SCENE

ERECTING A 5/8-WAVE ANTENNA

For those who have a full or novice amateur licence and are in a position to install a proper base station aerial, a commercial ⅝-wave CB antenna is an excellent proposition. Given appropriate preparation beforehand, installation can be completed single-handed in a few hours, after which it will give a permanent 3.5 to 4dB advantage over simpler installations.

by NEVILLE WILLIAMS

Typical of such antennas is one made by Archer, (Cat. No. 21-1133) sold by Tandy Electronics in Australia as a packaged kit for about $50.00. The carton contains all the necessary precut and predrilled aluminium tubes, a bottom loading coil and feedline connector already mounted, plus various brackets, clamps and sundry hardware. All you need to assemble it is a medium sized Philips screwdriver and a suitable handyman spanner.

Comparable ½ and ⅝-wave vertical antennas are offered by other suppliers and these should be checked for specifications, price and availability before proceeding. For obvious reasons, we could hardly expect to go through the erection procedure for all the aerials listed in catalogs and advertisements but our impression is that procedures and hardware are fairly uniform.

Physically, the Archer antenna is ⅝ wavelength long and, being intended for vertical mounting, it produces a doughnut shaped pattern, with 360-degree coverage and with the radiation concentrated parallel to the ground or at low angles of radiation. A loading coil extends it electrically to ¾ wavelength, providing for low impedance input to the bottom end. Three quarter-wave horizontal radials provide a ground plan against which the vertical sections work, while three small radials at very top of the antenna provide some top loading.

As with all such longer antennas, the specified gain is achieved by compressing the radiation and reception pattern into the required directional lobe—substantially parallel to the ground.

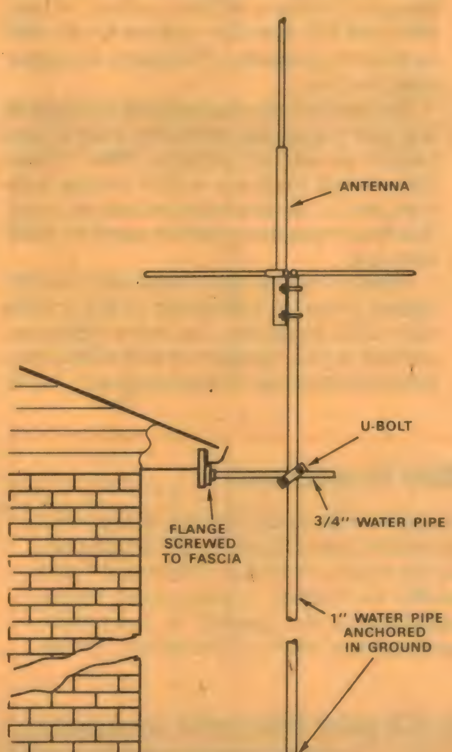
Facing the erection of such an antenna, the main problems have to do with its location relative to the dwelling and the means by which it is to be supported.

In general, it will be less obvious if it can be mounted away from the street frontage. At the same time, however, it should be no closer than it has to be to the neighbours' television antennas, while also ensuring that the cable run to the transceiver is manageable. In the face of such factors, the average amateur usually ends up with not too many options!

In one or two cases we have heard of, the family television aerial has been sacrificed to the cause. It has been placed elsewhere—under the tiled gable roof for example—and the 27MHz antenna mounted in its place. Provided the TV antenna support pipe is firmly anchored at a couple of well spaced points—wall and fascia for example—it should support the load of what is, after all, a slim and fairly light antenna.

The method suggested in the accompanying drawing should be adaptable to most cottages and will save having to compromise the TV antenna:

First off, a pipe flange was drilled and screwed to the fascia board and a length of ¾ in galvanised water pipe provided to screw into it. If you are a handyman, or know a few handymen, you shouldn't have any problem in finding an oddment length of pipe.

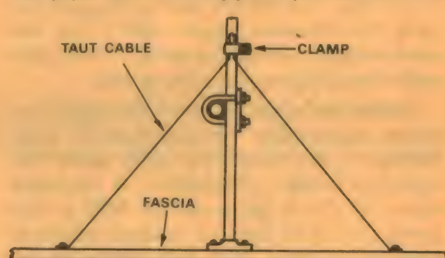


For the vertical support, we suggest a length of 1-inch galvanised waterpipe which will need to be anchored at least 1ft into the ground, (preferably standing on a scrap of brick or tile so that it won't tend to sink when the ground is sodden). It will need to extend far enough above the gutter line to support the antenna with the radials clear of the sloping roof.

In some cases you will need to use the whole of a 22ft length of pipe; in others, the installation will be more manageable and accessible with a few feet cut off the full length. It's all a matter of the height of your fascia above ground, the slope of the roof, the length and angle of the radials—and the size of ladder you can borrow and cope with!

If the vertical pipe can run close to the fascia, only a few inches of horizontal pipe will be needed to hold it clear of the guttering. On the other hand, if the vertical has to be stood away from the house, say to clear a path, the horizontal support will need to be much longer.

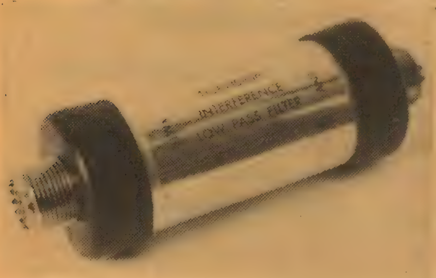
In this latter case, some bracing will be desirable and the diagram suggests a practical option for the handyman. Make up a bracing cable or wire long enough to run back from the end of the horizontal pipe to two support points on the cable, as provided by stout screws and washers. Push the cable under a clamp, pass something through the loop to prevent it pulling free, then tighten the clamp gradually, while tapping it out along the pipe until the support wires are taut.



At left: a simple but practical way to support a commercial 5/8 or ½-wave antenna. If the horizontal pipe is more than a few inches long, it should be stabilised with a cable as shown above. Needless to say, the fascia itself has to be firmly fixed and, if the antenna fixing screws can go into the rafters, so much the better.

Anchor the vertical pipe with the aid of a U-clamp, making sure that it is truly vertical, then tighten. Fill in the soil around the base and you have a stout

THE 27MHz SCENE



support pipe ready to receive the antenna—and automatically grounded as a precaution against the collection of static charges, or even a lightning strike.

Spelled out like this, it sounds easy, and it is easy provided that things have been carefully planned beforehand. For the flange and clamp, and possibly the pipe, you will need to visit a building supply store, making sure that you choose the right items. The flange should be prepainted to match the fascia and the pipe to match other pipework around the house, so that the installation will look more like part of the building than an afterthought.

Now comes the job of assembling the antenna itself and for the most part, it should simply mean following the instructions. We found it useful to vary the order, however, after having positively identified all the "bits".

The main whip was assembled first and here the constructor may be faced with a choice which is not in the instructions.

While we can't comment on other types, the segments in the Archer antenna are graded so that they slip easily into one another, being retained in position by gravity and a single self-tapping screw. We had the feeling that the fit was a little too "easy", leaving the possibility of some slight movement between sections which could get worse with wind movement. If you are of a fussy turn of mind, you may choose to split the end of the sections by an inch or so and add appropriate clamps, lacquering over to inhibit metal-to-metal corrosion.

It all depends on whether you are fussy, methodical or anxious to get it on the air!

We then added the inner radials, got the clamps ready and faced the job of getting it to the top of the support pipe. Provided you can get a good footing on the ladder or roof, and provided you have adequate space and no wind, the Archer antenna is light enough and rigid enough for one man to lift it in position and lightly clamp it to the top of the support. In this position, we were able to rotate it and add the outer lengths to the radials, after which the clamps were tightened.

At this point in time, the antenna needs only the connection of a suitable terminated length of 50-ohm coax cable to be ready for use—with one proviso mentioned in the instructions: the coax connection should be thoroughly taped to prevent moisture penetrating the connector or cable.

While most ground-plane type antennas have a natural input impedance of about 30 ohms, the Archer type has a primary winding associated with its built-in loading coil, which reflects a much more convenient 50 ohms. The manufacturers claim that, if used with good quality 50-ohm cable, a typical installation will show a standing wave ratio of not more than 1.2/1 over the whole 27MHz CB (or amateur) band. Moreover, the arrangement provides a DC path from aerial and feedpoint to ground so that, clamped to a grounded metal pipe, the system cannot collect static charges.

If you want to make the very best use of the antenna, Tandy will be delighted to supply you also with as much 50-ohm RG8 foam dielectric cable as you like, with the assurance that its losses at 27MHz will approximate only about 1dB per 100ft. There is just one small problem: it will cost $1.50 or more per yard!

Fortunately, the average amateur installation does not call for more than about 30ft of cable and some of the cheaper options do not carry all that much of a penalty for this sort of run at 27MHz.

At this frequency, the higher quality dielectric is not important and the advantage it confers is less than 0.1dB/100ft. The standard "heavy duty" RG8 cable, or its UR67 equivalent is offered by Dick Smith and others for about two-thirds the price of the foam variety.

Tandy offer a lighter gauge 52-ohm foam dielectric cable, type RG58 foam, for around 60c/metre and this is rated at something under 1.7dB/100ft attenuation at 28MHz. Power handling capacity at the same frequency is around 450W! Assuming the use of, say, 30ft, the likely attenuation would be 0.5dB, as compared with about 0.3dB for the larger and more expensive RG/8 types. Thus, at half or a third the price, the actual signal loss involved for 30ft of cable would be a quite negligible 0.2dB.

These figures, derived from tables work out very closely in practice. Checked with a 5W transmitter, operating through 30ft of cable into a 50-ohm load and a power meter, the measured difference between RG/8 foam and RG/58 foam was 0.3dB—too small to be noticed in practice.

Even standard quality RG-58 cable should not be discounted, despite its modest price (35c/m from Dick Smith Electronics). Attenuation at 27MHz is about 2.2dB/100ft, or 0.66dB/30ft—a mere 0.1dB behind the foam equivalent.

By all means buy the best cable you can afford—50-ohm cable, that is—but don't feel deprived if you have to settle for something less expensive. At this frequency and for a modest run, it's doubtful whether you'd ever notice the difference!

One other point is worth mentioning in the context of installing a fixed, higher gain antenna—the possibility of running into problems with TVI (or television interference) into your own or neighbouring receivers.

TVI can result from the radiation of harmonics by a badly adjusted transmitter, from splatter due to excessive modulation, or to radiation of crystal or other source frequencies even in the "receive" mode. Situations like this are the responsibility of the person operating the transmitter.

More often than not, however, TVI problems relate to the receiver: inadequate front-end selectivity, a tendency to overload and intermodulate in the presence of a strong signal, or direct penetration of the 27MHz carrier into the IF system. While, the amateur station operator may legitimately take up a "my transmitter's okay" position, it doesn't make it any easier to live alongside neighbours whose TV enjoyment is being compromised!

A typical high-pass filter intended for use with TV receivers using 300-ohm ribbon. It attenuates signals below about 45MHz.

Curiously, TVI problems most frequently occur with TV sets operating from rabbit-ear or other "portable" aerials. Properly installed outdoor or under-tile aerials, with designed gain and directional qualities, pick up more of the wanted TV signal and proportionately less of the local out-of-band signal.

Not surprisingly, these problems have had to be faced by CB operators overseas and two fitments are available as catalogue items for a few dollars. Unfortunately, shortage of supply from overseas, and local demand have conspired to make them rather scarce and you may

(Continued on page 117)

CB OPERATING CONVENTIONS

FREQUENCIES: USA Class D, 23 Channel

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
1	26.965	9*	27.065	17	27.165
2	26.975	10**	27.075	18	27.175
3	26.985	11	27.085	19	27.185
4	27.005	12	27.105	20	27.205
5	27.015	13	27.115	21	27.215
6	27.025	14	27.125	22	27.225
7	27.035	15	27.135	23***	27.255
8	27.055	16	27.155		

* Provisional emergency channel for Australia.
** Regarded by some truckers as "our channel".
***Falls outside Australian Amateur Radio allocation.

FREQUENCIES: USA, Extension to 40 Channel*

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
24	27.235	30	27.305	36	27.365
25	27.245	31	27.315	37	27.375
26	27.265	32	27.325	38	27.385
27	27.275	33	27.335	39	27.395
28	27.285	34	27.345	40	27.405
29	27.295	35	27.355		

*In Australia, these frequencies bracket existing allocations to hospitals, Army, RAAF, Fire Services and Telecom.

THE "10" SIGNAL CODE

CODE MEANING

10-1 Receiving you poorly.
10-2 Receiving you well.
10-3 Channel in use.
10-4 Message received.
10-5 Relay message.
10-6 Busy. Can't talk now.
10-7 Out of service. Going off air.
10-8 Back in service after shut-down.
10-9 Repeat message.
10-10 Was 10-6. Now on call.
10-11 Talking too rapidly.
10-12 Visitors are present.
10-13 Advise weather, road conditions.
10-14 Time by the clock.
10-17 Important business.
10-18 Anything for us?
10-19 Return to base.
10-20 My location is:
10-21 Contact me by phone.
10-22 Make personal contact with:
10-23 Stand by.
10-24 Assignment completed.
10-25 Contact another station by radio.
10-26 Disregard last transmission.
10-27 I am moving to channel:
10-28 Proper station identification.
10-29 Time is up for contact.
10-30 Violates regulations (FCC or equiv).
10-31 No longer in violation of regs.
10-32 I will advise re. readability of signal.
10-33 Emergency traffic at this station.
10-34 In trouble; need help.
10-35 Matter of urgency but cannot discuss it by radio.
10-36 Transmission or event is scheduled for:
10-37 Send tow truck.
10-38 Injuries; send ambulance.

CODE MEANING

10-39 Your message was delivered.
10-41 Moved to another channel.
10-42 Traffic accident at:
10-43 Traffic congestion at:
10-44 I have a message for:
10-45 Stations on this channel please identify.
10-50 Break.
10-60 What is the next message number?
10-62 Unable to copy; use phone.
10-63 Net directed to:
10-64 Net clear.
10-70 Fire at . . .
10-84 My telephone number is . . .
10-85 My address is . . .
10-89 Radio repairman needed at . . .
10-92 Your transmitter needs adjustment
10-94 Please give me a long count
10-100 Rest stop

FOOTNOTE: 10-Code signals may represent a statement or be posed as a question. Some discrepancies in meaning are apparent from published lists.

PHONETIC ALPHABET

A — ALFA	N — NOVEMBER
B — BRAVO	O — OSCAR
C — CHARLIE	P — PAPA
D — DELTA	Q — QUEBEC
E — ECHO	R — ROMEO
F — FOXTROT	S — SIERRA
G — GOLF	T — TANGO
H — HOTEL	U — UNIFORM
I — INDIA	V — VICTOR
J — JULIETT	W — WHISKEY
K — KILO	X — X-RAY
L — LIMA	Y — YANKEE
M — MIKE	Z — ZULU

R-S SIGNAL REPORTS

READABILITY

1—Unreadable.
2—Barely readable, occasional words distinguishable.
3—Readable with considerable difficulty.
4—Readable with practically no difficulty.
5—Perfectly readable.

SIGNAL STRENGTH

1—Faint signals barely perceptible.
2—Very weak signals.
3—Weak signals.
4—Fair signals.
5—Fairly good signals.
6—Good signals.
7—Moderately strong signals.
8—Strong signals.
9—Extremely strong signals.

THE "Q" CODE

The Q code was originally devised as a means of speeding up communication between operators using Morse Code. A Q-code letter group may serve as a statement or it may be posed as a question—in Morse Code simply by adding to it a question mark.

Q-code letter groups have tended to carry over to speech communication as jargon, needlessly displacing plain language words.

Listed below are the Q-code letter groups most likely to crop up as jargon in speech transmissions.

QRM Your transmission is being interfered with. Is my transmission . . .?
QRN My reception is marred by static. Is your reception being marred . . .?
QRO Please increase your power (if possible). Shall I increase power?
QRP Please reduce your power (if possible). Shall I reduce power?
QRT Stop sending (or transmitting). Shall I stop sending or transmitting?
QRV I am ready. Are you ready?
QRX I will call you again at . . (time) on . . (Freq). Will you call me again . . .?
QRZ You are being called by . . on . . (Freq). Who is calling me?
QSL I will acknowledge receipt (by card, &c). Will you acknowledge receipt?
QSO I can communicate with . . . Can you communicate with . . .?
QSP I will relay to . . . Will you relay to?
QSY I will change frequency to . . . Can you change frequency to . . .?
QTH My location (more commonly home station address) is . . . What is your. . .?
QTR The time is . . . What is the correct time?

Electronics as an aid to motoring safety

A hazard flasher for your car

In this article we present details for two different car hazard warning flasher circuits. Both circuits use a minimum of parts, and could be fitted to most types of cars which do not already have this facility.

by GREG SWAIN

Almost everyone who drives a motor vehicle will, at some stage during their driving career, be confronted with an emergency situation. Typical scenarios commonly include a vehicle which has become stationary in the traffic pattern, thereby creating an instant hazard. This could be due to mechanical breakdown, unsafe road conditions, a traffic accident, or a flat tyre.

The element of danger can be quite high, particularly in heavy traffic, at night and in wet weather. And breakdowns in wet weather due to wet ignition systems are a common occurrence.

What is obviously needed in such situations is some kind of hazard warning system, and many late model cars are in fact equipped with hazard warning lights. This especially applies to vehicles of European and Japanese origin. But a large percentage of vehicles on the road, particularly those of Australian origin, are not so equipped.

It is not surprising, therefore, that we have received quite a few requests from readers to publish details of a circuit which could be fitted to a vehicle to provide a hazard warning function. This would normally involve simultaneously flashing all four turn indicator lamps at a suitable rate.

If we have been reluctant to publish circuit details until now, it is mainly because of the hassle involved in fitting a unit of this type into a vehicle and interfacing it with the existing wiring system. While most automotive circuitry is quite basic, the practical execution can represent a nightmare to anyone not familiar with the layout. Then there is the problem of accessibility—easy in some vehicles, next to impossible in others.

Another problem is that wiring configurations differ from one make of car to the next. For example, on some vehicles the rear turn indicator lights also function as the reversing lights; other vehicles use separate reversing lights, while others again use double filament globes to provide for the two functions.

So what may appear at first sight to be a relatively straightforward task can in practice prove quite difficult, depending on the vehicle. It's not the circuitry that is the problem; it's the difficulty of fitting the circuit into an existing automotive wiring system, a system that was never designed to accept such an add-on unit in the first place. Anyone who has ever attempted to trace through the wiring diagram in their workshop manual will quickly appreciate this.

It was against this background that we mocked up the following two circuits in the lab. We are not showing constructional details, because of the likely limited appeal of this type of project. The two circuits are quite basic, and those readers sufficiently competent to modify the wiring system of their vehicle should have little difficulty in devising a suitable method of construction.

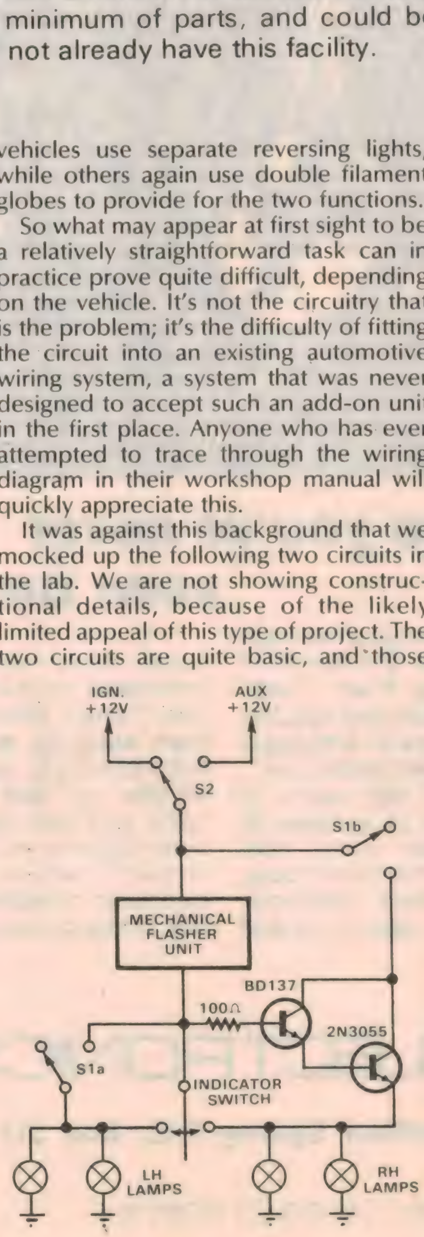


Fig. 1: this circuit makes use of the vehicle's existing mechanical flasher unit. Awkward fitting to some vehicles detracts from its simplicity, however.

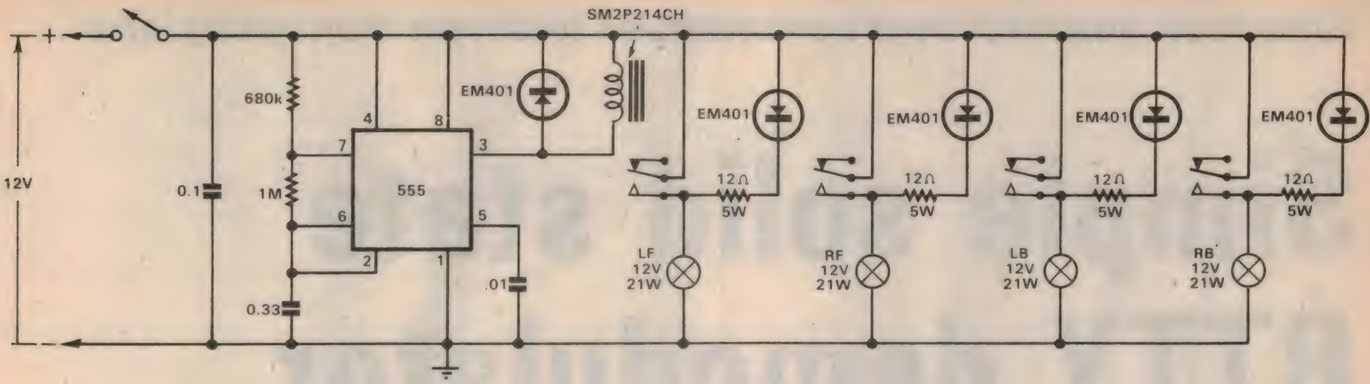
The most basic circuit of the two is shown in Fig. 1. It consists simply of two NPN transistors (BD137, 2N3055) operating as a Darlington pair, and a 100 ohm base current limiting resistor. This circuit is interfaced to the existing mechanical flasher unit in the vechicle. Circuit operation is as follows:

When S1a and S1b are closed, the two left hand (LH) turn signal lamps are driven by voltage pulses from the mechanical flasher unit. The mechanical flasher also drives the Darlington pair, which in turn drive the two right hand (RH) turn signal lamps. Switch S2 is used to bypass the normal supply through the ignition switch, so that the hazard warning lights can function with the ignition switch in the "OFF" position.

The 100 ohm resistor limits the current flowing from the flasher unit into the base of the BD137 to about 100mA. The extra loading on the flasher unit is thus quite small, and the change in flash rate negligible. It is normal for the 2N3055 to become quite warm during operation, and it should be provided with suitable heatsinking.

Note that the normal supply through the ignition switch must be disconnected by S2. Simply switching in the auxiliary power supply as well would have the effect of turning the ignition on, regardless of the position of the ignition switch. Note also that the circuit is only suitable for negative earth cars.

S1a and S1b should be a double pole, two position switch with contacts rated at 5A. A separate switch will probably have to be provided for S2, and this should have a contact rating of some 10A. However, if a suitable three pole switch is available, then this may be used instead (combining S2 and S1).



CAR HAZARD WARNING FLASHER

3/AU/-

Fig. 2: switching arrangements can be considerably simplified by using a 555 IC timer to drive a relay.

In spite of its simplicity, the circuit presented in Fig. 1 has a number of practical disadvantages. The worst of these is that the two RH lamps will not flash as brightly as the two LH lamps, this effect being slight but noticeable. This is due to the saturation voltage of the 2N3055 transistor, typically around 1.6V.

Another problem is that although we have shown the LH and RH lamp pairs as normally wired in parallel, this will not always be the case. For example, on vehicles where the rear turn indicator lamps also function as reversing lights, the front and rear lamps are normally only connected in parallel when the turn indicator switch is activated. In these cases, additional switching will have to be provided to switch the front and rear lamps in parallel when the hazard warning flasher is to be used. This switching would be best performed by a 12V relay connected between the 2N3055 collector and ground.

Switching for the circuit shown in Fig. 1 can thus become quite complex, detracting considerably from the essential simplicity of the Darlington pair arrangement, and making the unit difficult to fit into some vehicles. The switching complexity arises because the circuit utilises the existing flasher unit in the vehicle.

One way of overcoming this complexity is to provide a completely separate circuit for the hazard warning flasher. By so doing, it is possible to interface each indicator globe separately, thus considerably simplifying the fitting of the unit and overcoming the problem of different wiring configurations in different vehicles.

A suitable circuit is shown in Fig. 2. A 555 type IC timer circuit is used in conjunction with a 12V relay employing four changeover contacts.

Advantages of this new circuit include: simplified fitting to the vehicle; no alterations required to existing circuitry; and all lamps glow with equal brilliance. The main disadvantage has to do with cost.

The 680k and 1M resistors, together with the 0.33uF capacitor, set the timing, while the ratio of the two resistors determines the duty cycle. The values chosen give a flash rate of around 100 flashes per minute, and a duty cycle of 60%. The relay is driven directly from the output of the 555 timer.

Note that a protective diode is required in parallel with the relay terminals to prevent latch-up due to inductive spikes when the relay is de-energised. The relay contacts should be rated as 2A. A suitable relay type, the SM2P214CH, is available from Radio Despatch Service, 869 George St, Sydney.

The 12 ohm 5W resistors serve to preheat the lamp filaments during the "off" duty cycle. This measure reduces surge current through the relay contacts at turn on, and results in longer lamp life. The series diodes are to isolate the four indicator lamps from each other when the hazard flasher is not in use.

The 0.1uF bypass capacitor is fitted as a precautionary measure to prevent ignition transients and surges due to load changes on the car electrics from falsely triggering the timer. In some cases, it may be necessary to fit a 1000uF 16VW electrolytic capacitor as well.

As before, the circuit should be wired into the vehicle so that the hazard warning lights can function with the ignition switch in the off position. A convenient power take-off point can often be found at or near the fusebox. A 10A automotive fuse should be included in the positive supply rail (both circuits).

The method of construction for this unit is not critical, and any accepted technique may be used. But make sure that you do the job neatly and carefully. Automotive wiring is generally very reliable, and this reliability should not be jeopardised by sloppy workmanship.

Finally, a word of warning. Many cars incorporate a fusible link in the wiring harness to reduce the risk of fire in the event of an electrical malfunction. This fusible link should not be bypassed.

Tune into amateur and commercial teletype transmissions

Simple solid state RTTY demodulator

Now that surplus Baudot teleprinters are readily available, interest in the information transmitted over the commercial radio-teleprinter networks, as well as in amateur radio transmissions, is increasing. In order to be able to print out these messages, it is necessary to demodulate the received signals. In this article, we present the design of a suitable demodulator unit.

by DAVID EDWARDS

Radioteletype (commonly abbreviated to RTTY), is a system of communication based on sending information in serial binary encoded form over a wireless link. Coding and decoding of the information is performed by mechanical means, such devices being known as teleprinters. Historically, teleprinter machines were first developed around 1906, and were originally intended for use on telegraph lines.

With the advent of radio communication, the technology was adapted for use with this new medium. At the present time, many of these machines, or their modern derivatives, are still in use throughout the world. Their main use is in transmitting news information and propaganda. Other broadcasts are concerned with weather information, and as well there are broadcasts by licensed amateur radio operators.

The unit to be described in this article will enable commercial and amateur RTTY signals to be copied off air. There are no setting-up adjustments to be made during construction, and no adjustments required during operation.

Information is normally transmitted at a 45 or 50 baud rate (a baud is a bit/second) using some form of frequency shift keying (FSK). With this technique, a binary "1" is sent as one frequency, known as the "mark" frequency, and a binary "0" is sent as an adjacent frequency, known as the "space" frequency. The frequency difference between the two is known as the shift.

Our new terminal unit will cope with 45 and 50 baud transmissions, and with frequency shifts in the range 50 to 1000Hz. Normal shifts are 170 or 850Hz. The inherent design of the unit ensures that moderate receiver drift will not cause erroneous printouts.

A centre-zero meter is provided to aid in tuning the receiver for maximum performance. A polarity switch enables signals to be correctly decoded even if the receiver is tuned so that "mark" and "space" are transposed. A second switch enables the teleprinter to be supplied with a permanent "mark" during tuning operations, thus preventing noise signals from printing.

Before discussing our RTTY Terminal in detail, some background on the teleprinter system is perhaps in order.

Being designed originally for telegraphy, teleprinters are digital devices. And as they were developed for use over two-wire lines, they transfer the information in serial form. Each character is sent and received as a sequence of bits, with the number of bits per character and their transmission rate being fixed for a given type of machine and system.

Each character is preceded by a fixed start bit, to identify the beginning of the character. Then there are a number of data bits, which are a coded representation of the character, followed by a stop bit.

The character bit sequences are generated at the teleprinter keyboard by a rotary commutator switch, known as the "transmitter distributor". This has a number of fixed contact segments, one for each of the total number of bits in the character sequence, and a rotating brush contact driven by a fixed-speed motor via a clutch. The rotating brush is connected to a power supply, generally a constant-current type designed to deliver either 20 or 60 mA.

With no key pressed, the clutch is disengaged, and the distributor remains stationary. The brush contact touches a commutator segment permanently connected to the output line, so that the line receives current. This is known as the idle or "mark" condition.

When a key is pressed, a mechanical encoding system first operates a number of fixed switches. These open or close the connections between each of the various "data bit" segments of the commutator and the output line, setting up the coding of the character to be sent. Then the drive clutch is engaged, whereupon the motor rotates the distributor through one revolution. As it rotates, the brush contact effectively "scans" the various segments.

After leaving its idle position, the brush first contacts a segment which is per-

TABLE 1 : BAUDOT CODE

CHARACTER		CODE				
LETTERS	FIGURES	B1	B2	B3	B4	B5
A	–	1	1	0	0	0
B	?	1	0	0	1	1
C	:	0	1	1	1	0
D	$	1	0	0	1	0
E	3	1	0	0	0	0
F	! (OR %)	1	0	1	1	0
G	& (OR @)	0	1	0	1	1
H	STOP (OR £)	0	0	1	0	1
I	8	0	1	1	0	0
J	, (OR BELL)	1	1	0	1	0
K	(	1	1	1	1	0
L	)	0	1	0	0	1
M	.	0	0	1	1	1
N	,	0	0	1	1	0
O	9	0	0	0	1	1
P	0	0	1	1	0	1
Q	1	1	1	1	0	1
R	4	0	1	0	1	0
S	BELL (OR ! OR ')	1	0	1	0	0
T	5	0	0	0	0	1
U	7	1	1	1	0	0
V	; (OR =)	0	1	1	1	1
W	2	1	1	0	0	1
X	/	1	0	1	1	1
Y	6	1	0	1	0	1
Z	" (OR +)	1	0	0	0	1
SPACE		0	0	1	0	0
CARRIAGE RETURN		0	0	0	1	0
LINE FEED		0	1	0	0	0
"LETTERS"		1	1	1	1	1
"FIGURES"		1	1	0	1	1

manently open circuit. This breaks the line circuit, to generate a no-current or "space" bit at the start of every character—i.e., the start bit. Then the brush scans the data bit segments, in each case making (mark) or breaking (space) the line circuit depending upon the coding set up for the character concerned. Finally the brush contacts one or more segments which are permanently connected to the line, to generate one or more mark bits—the stop bits.

At the end of the cycle the clutch disengages to bring the distributor to a halt, with the brush still in contact with the last stop bit segment. The machine thus stops with the line circuit made once more—i.e., in the mark condition.

The printer mechanism of the receiving teleprinter uses a similar technique to the keyboard in order to produce printed characters from the incoming serial bit sequences. There is again a rotating assembly driven via a clutch from a constant-speed motor, but in this case it is a set of selector cams which control the actuation of mechanical decoding linkages from an electromagnet. The electromagnet, known as the "selector magnet", is also used to control the driving clutch.

The signalling current flowing in the line is used to energise the selector magnet, and accordingly the magnet remains energised while ever the transmitting teletype is idling. In this situation the printer clutch is held disengaged by the magnet, and the printer does not operate.

As soon as a character begins to be transmitted, the line current is broken for the duration of the start bit. This causes the printer selector magnet to release, allowing the clutch to engage. The selector cams begin to rotate, from their rest position. As they rotate, they allow their corresponding printer mechanism decoding linkages to be actuated by the selector magnet, if it is energised, at the appropriate instants during the cycle (corresponding to the various data bits).

At the end of the last data bit, the printer decoding linkages have thus been set up according to the coding of the transmitted character. A further linkage actuated by the selector magnet at the beginning of the stop bit is then used to activate the printing mechanism and print the character. At the same time the energised selector magnet disengages the selector cam clutch, to end the cycle.

As you can see, the system relies upon the motors of both machines rotating their respective mechanisms at identical speeds. Angular synchronism is achieved by having fixed idling positions, and by having the printer "triggered" into synchronism with the transmitted character by the action of the start bit in causing the selector magnet to engage the clutch.

In practice, there can be a small difference between the motor speeds of the two machines, because the systems are resynchronised at the start of every character. Provided that the difference is not so great that information bits are misinterpreted because of their relative time shifts, correct copy will be received.

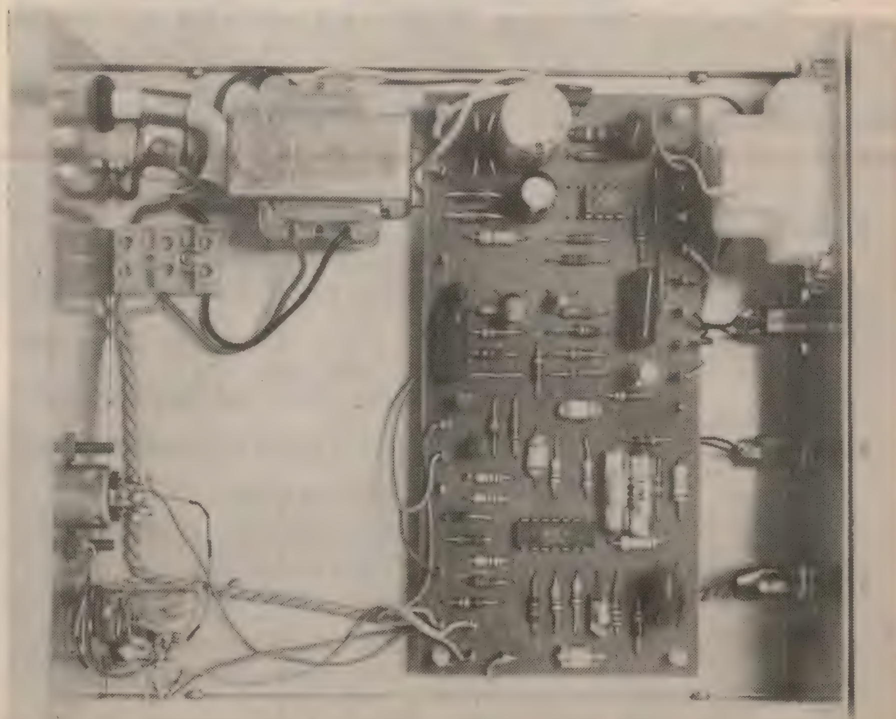
The code used with most teleprinter equipment used for RTTY is the Baudot code. Table 1 is a listing of it. Astute readers will notice that only five bits are used, yet the code manages to achieve a total of 57 different characters, as opposed to the 32 one would expect from five bits.

This apparent miracle is achieved by utilizing a "phantom" sixth bit, which is in effect transmitted only when it changes value. This is done by means of two special control characters, "letters" and "figures".

Depending upon which of the two control characters has been sent last, the receiving equipment interprets each encoded character in two alternative ways.

If the "letters" control character has been sent last, the encoded characters which follow are assumed to be alphabetic characters. If on the other hand the "figures" control character has been sent last, the characters which follow are assumed to be either numerals, punctuation marks, or non-printing characters.

In other words, the Baudot code is not really a 5-bit code, but is equivalent to



Use stakes to make external connections from the board. Note the 68 ohm resistor wired directly across the TTY output socket.

a 6-bit code. The information which would otherwise be carried by a sixth bit is sent only when required, in the form of the two control characters "figures" and "letters".

Transmission speeds have generally increased as time has passed, with the first machines operating at 45 bauds and later machines at either 50, 75, 110 or 150 bauds. However, our main concern here is with 45 or 50 baud machines, as these are the most commonly available.

Two machines of the type we have described so far can be connected together by wires alone, with the keyboard of one machine controlling the printer of the other, and vice versa. In fact, a single teleprinter can be connected in what is known as a "local loop", so that the keyboard controls the printer directly.

The selector magnet in the printer has two windings, which can be connected either in series or parallel. In the series connection, a current of 20mA is required for reliable operation, while for parallel operation, 60mA is required. To set up a local loop, the keyboard contacts are used to control a current source (either 20 or 60mA as required).

For distant operation with two machines, two such circuits are required. With RTTY, these links are replaced by radio links. In order to fully understand the operation of the RTTY Terminal, it is necessary to know a little about the types of transmissions commonly used.

In general, some form of frequency shift keying (FSK) is used, as this gives good results on noisy signals. Direct FSK is normally used with an 850Hz shift, the higher frequency usually representing the mark, and the lower the space. Shifts of less than 850Hz are also in use.

The second type of transmission is known as audio frequency shift keying (AFSK). A continuously transmitted carrier is modulated with two audio tones, one of which corresponds to mark, and the other to space. The standard audio frequencies are 2125Hz and 2975Hz, giving an 850Hz shift as before.

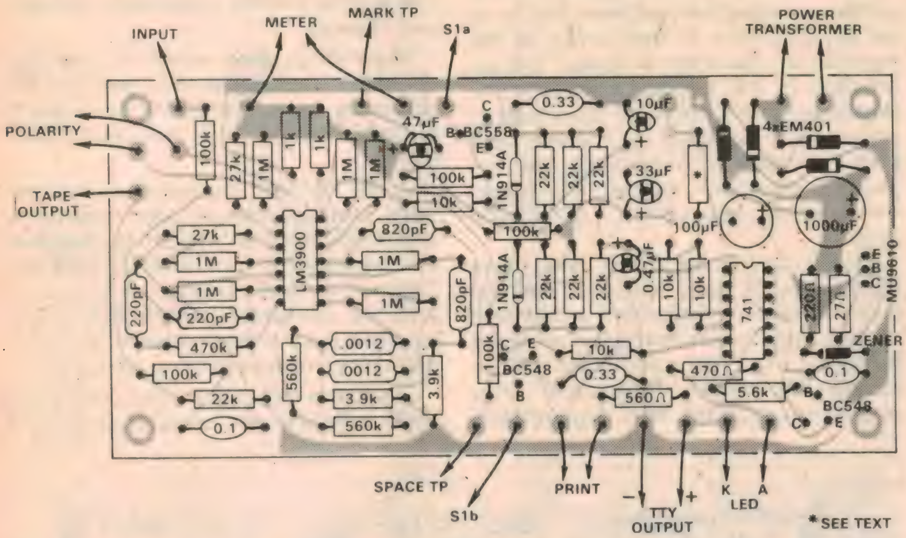
With either type of transmission, the appropriate receiver will produce identical signals at the audio output. This will be an audio tone, shifting between 2125Hz and 2975Hz, with the upper frequency corresponding to mark. The RTTY Terminal then has the function of converting these tones into the appropriate current pulses.

Turning now to the circuit diagram, we can discuss the operation of the circuit. A quad Norton operational amplifier is used to process the input signal, along with a 741 op-amp and two silicon transistors. The unit is powered from a 12V rail, derived from a small transformer by a diode bridge and simple active regulator.

Amplifier A is connected as a band pass filter. It has a gain of approximately 5, and a centre frequency of 2.5kHz. This allows it to pass signals between 2 and 3kHz without significant attenuation, while at the same time limiting the amount of high frequency noise and low frequency hum.

As well as being fed to the rest of the circuit, the output from this amplifier is attenuated by 1/5th and made available, along with the input signal, at a 5 pin DIN tape socket. This will allow recording and replay of off air signals using a standard audio tape recorder. Since the recording signal is obtained from the output of amplifier A, the signal to noise ratio should be improved over a direct recording.

Amplifier B is connected as a Schmitt trigger, and serves to provide a constant amplitude input signal for the next stage. The component values have been chosen to provide a "window" of about 600 mV. Combined with the gain from the previous stage, this gives an input



The overlay pattern for the PC board, viewed from the component side.

PARTS LIST

SEMICONDUCTORS

1 LM3900 quad Norton op-amp
1 741C op-amp
2 BC548 NPN transistors, or equivalent
1 BC558 PNP transistor, or equivalent
1 TT801, MU9610 NPN transistor, or equivalent
4 EM401 silicon diodes
2 1N914 silicon diodes
1 13V 400mW zener diode
1 red light emitting diode (LED)

RESISTORS (all ¼W unless stated otherwise)

8 1M, 2 560k, 1 470k, 5 100k, 2 27k, 7 22k, 6 10k, 1 5.6k, 2 3.9k, 1 560 ohm, 1 470 ohm, 1 220 ohm, 1 68 ohm, 1 27 ohm 1W

CAPACITORS

1 1000uF 25VW PCB electrolytic
1 100uF 16VW PCB electrolytic
1 47uF 6.3VW tag tantalum electrolytic
1 33uF 10VW tag tantalum electrolytic
1 10uF 25VW tag tantalum electrolytic
1 0.47uF 35VW tag tantalum electrolytic
2 0.33uF polyester
2 0.1uF polyester
2 1200pF polystyrene
2 820pF polystyrene
2 220pF polystyrene

MISCELLANEOUS

1 transformer, 240V to 12V at 200mA, PF 2851 or similar
1 case, 70 x 160 x 184mm, see text
1 PCB, coded 77tty3, measuring 142 x 69mm
4 9.5mm (⅜") PCB standoffs
1 mains cord, mains plug, grommet, cord clamp and terminal block
1 6.5mm jack socket
1 6.5mm jack socket with switch
2 6.5mm phone plugs (mono)
1 5 pin DIN panel socket
1 5 pin DIN plug as required
1 DPDT miniature toggle switch
2 SPDT miniature toggle switches
1 100-0-100uA FSD centre zero edge reading meter
Solder, rainbow cable, machine screws and nuts

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with high ratings may generally be used provided they are physically compatible.

sensitivity for the terminal of about 50mV RMS.

The remaining two Norton amplifiers are connected as band pass filters also. One has a centre frequency of 2kHz, while the other has a centre frequency of 3kHz. Their inputs are connected to the output of amplifier B.

After passing through the DPDT polarity switch, the outputs from the filters are buffered by complementary emitter followers, and rectified by diode/capacitor combinations. One output has its positives peaks rectified, while the other has its negative peaks rectified. The resulting voltages are then summed by 22k resistor combinations.

The signals at the emitter followers are also made available, via 100k resistors, for monitoring on a CRO. Normal practice is to use the mark signal for Y deflection, and the space signal for X deflection. A "cross" display which shows the relative strengths of both signals then results, and this can be used as an aid to receiver tuning.

The first pair of resistors has its junction fitered by a 10uF capacitor. The voltage across this capacitor is monitored by the centre zero tuning meter.

This is a form of ratio detector, and will give an output voltage which will vary with input frequency. At approximately 2.5kHz, the output level from each filter will be the same, at a nominal 6V, so that the meter will indicate zero. For frequencies either side of this, a corresponding deflection will be obtained.

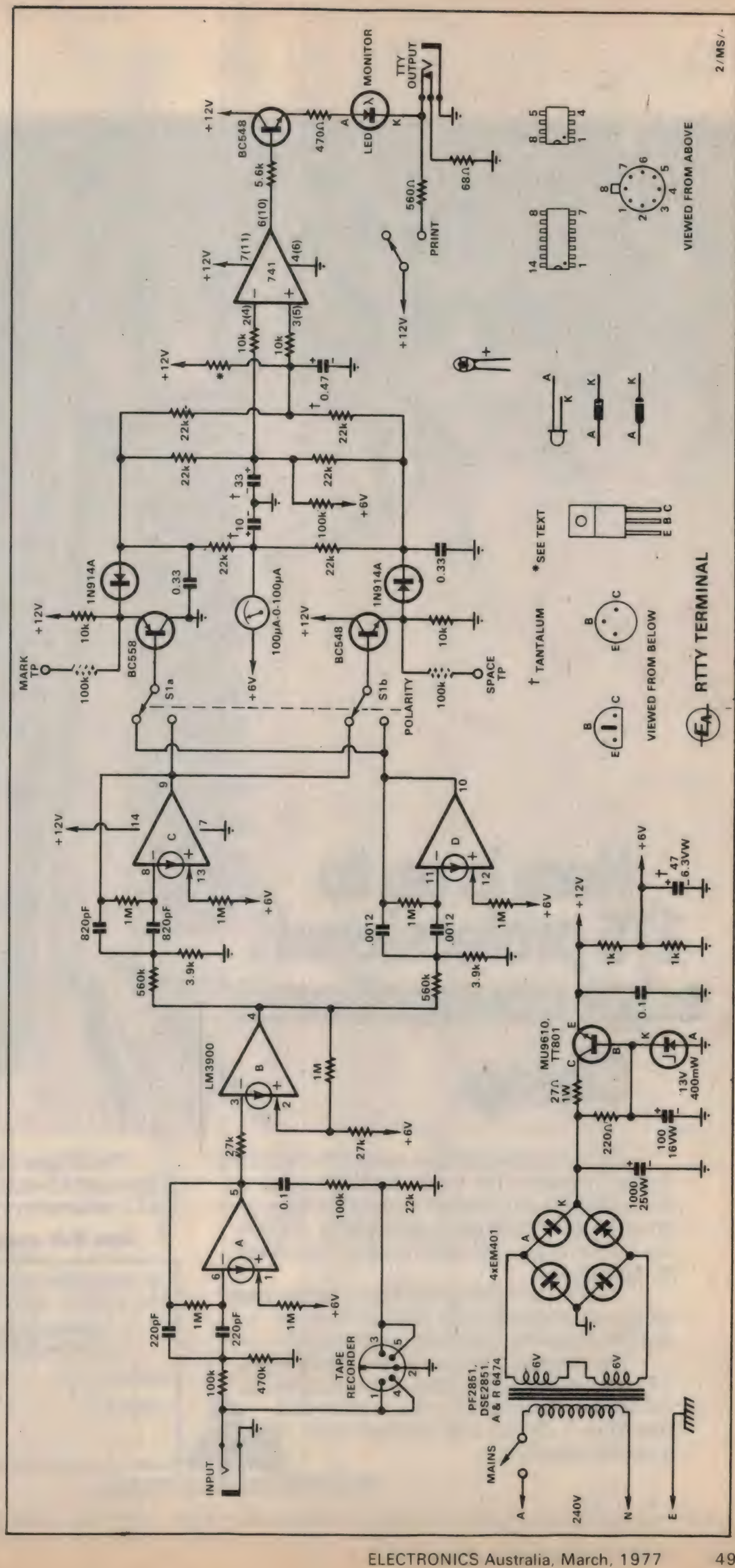
If an output signal is applied to the circuit which varies in frequency, the meter will give a relative indication of the frequency. The amplitude of the signal is almost immaterial, provided that it exceeds the input threshold of 50mV RMS.

A received teleprinter signal will normally be within the operating range of the circuit. It will be switching between two frequencies in the range 2 to 3kHz, with a shift of approximately 850Hz or less. Each frequency will last for at least 20msec for a 50 baud transmission.

The second and third resistor pairs connected to the detector are also filtered with tantalum capacitors. The 33uF value used for the second pair ensures that it will not respond to the variations in voltage caused by the signal frequencies, but instead will respond only to the average input frequency.

The 0.47uF value used with the third pair allows them to respond to the voltage variations caused by the variations in signal frequency. Thus the voltage on the third pair will swing up and down with respect to the voltage on the second pair, corresponding to the received marks and spaces.

The 741 op-amp is connected as a comparator across the second and third pairs of resistors. This means that its output will switch at the same rate as the input signal, and will duplicate the coding of the input signal.



RTTY demodulator

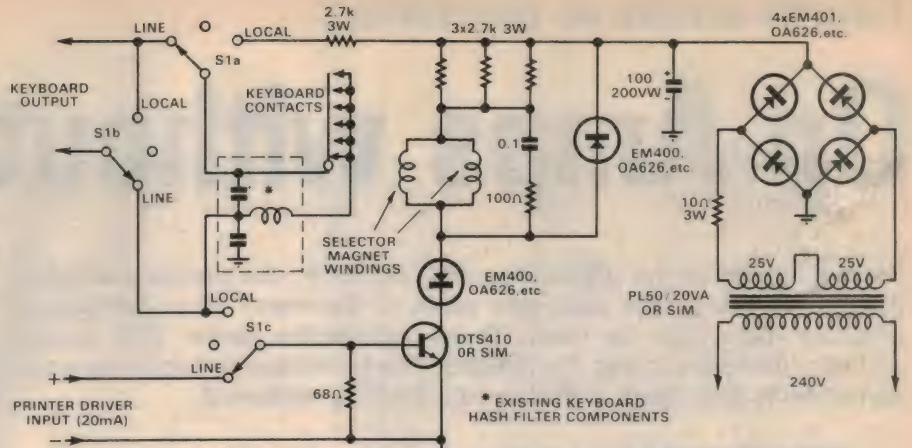


FIG. 2 : BAUDOT TELEPRINTER SIGNAL WIRING

The starred (*) resistor shown connected to the comparator input serves to bias the 741 so that in the absence of an input signal, a mark output is generated. Further details will be given later in the article.

The 100k resistor connected between the +6V rail and the 33uF tantalum capacitor improves the performance of the terminal when copy is being received at a very slow rate. It ensures that when a continuous signal is being received, the comparator is held in the state corresponding to mark.

An emitter follower is used to enhance the output current capabilities of the 741. It drives a LED indicator lamp via a 470 ohm resistor. The LED current is passed to ground via either a 68 ohm resistor or the base-emitter junction of the selector magnet driver transistor (see Fig. 2).

The print switch connects a 560 ohm resistor to the driver transistor base, ensuring the presence of a mark condition when printing is to be inhibited.

We recommend that the teleprinter be wired as shown in Fig. 2. This can easily be incorporated in the machine case. It uses only a few easily obtained parts. The driver transistor shown is a Delco DTS410, but any similar high voltage medium power NPN transistor would be suitable. It is operated in switching mode, and does not dissipate significant power.

The circuit of Fig. 2 shows switching which allows the keyboard and printer driver to be connected together for "local" operation, if desired. This is not essential, but we have found it convenient.

We are indebted to Mr Peter Fitzpatrick, of Network Engineering, 492 Jones St., Ultimo, NSW for much helpful advice and ideas during the initial design development. His firm is able to supply surplus model 15 Teletypes, as well as other models, at quite reasonable rates. In fact, the protoype terminal was tested on a machine kindly provided by him.

Construction of the RTTY Terminal should be within the capabilities of the average constructor. All of the components are mounted on a printed circuit board, coded 77tty3, and measuring 142 x 69mm. Printed circuit board stakes are recommended for the external connections to the board, and twenty are required. We mounted the board in a low-cost utility case available from Dick Smith Electronics Pty Ltd.

It has an aluminium chassis, and a steel cover, and measures 70 x 160 x 184mm. We mounted the board on plastic PCB standoffs, towards the front of the case. The mains transformer is mounted in the rear right hand corner, as shown in the photographs.

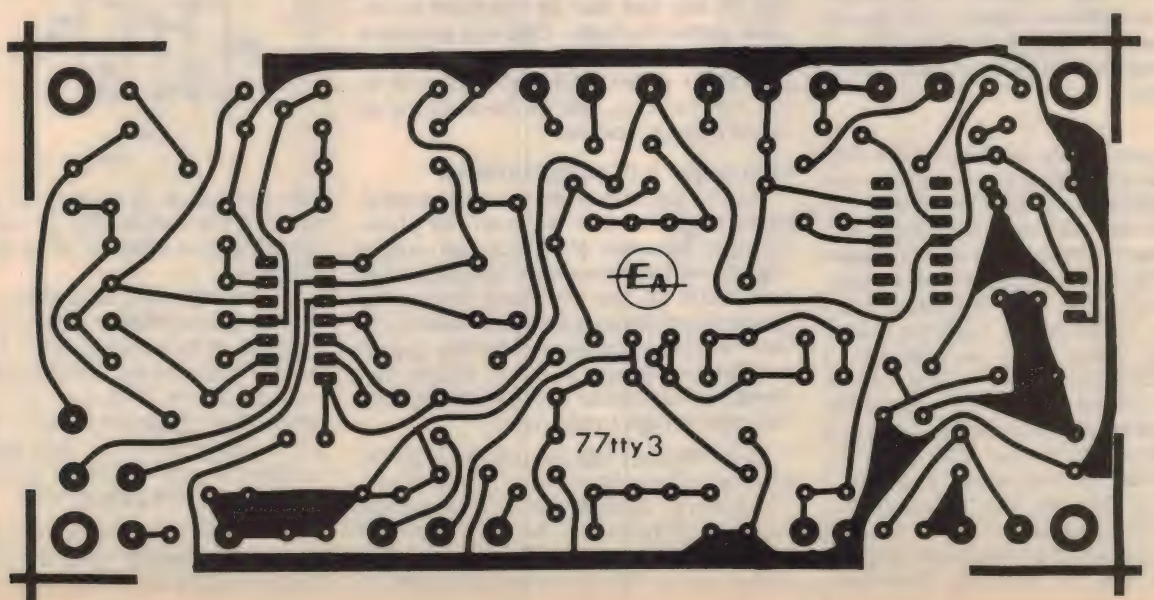
The connections to the switches and other front panel components, and to the sockets on the rear panel can be made with rainbow cable. This makes later trouble-shooting much easier, and gives a neat appearance to the finished project.

When construction is completed, the unit can be tested. Apply power, and check that there is about 12V on the emitter of the power supply series pass transistor. Do not at this stage connect the unit to the teleprinter.

If the LED is on, all is well. However, if it is not, it will be necessary to add the starred resistor between the comparator input of the 741 and the positive supply rail. Try a 10 megohm one to start with, and decrease the value if necessary.

That completes construction of the RTTY Terminal, so you can now connect up the teleprinter and start to search the airwaves for suitable signals. We have found useable signals at various points in the frequency spectrum between 2 and 20MHz. Do not be disappointed if a lot of signals refuse to make sense, this is because a lot of commercial transmissions are in cypher. However, plain English transmissions do exist, so keep persevering. With luck you may even receive a picture!

Below is an actual size reproduction of the PC board.



Fourth article in our series:

Op-Amps without tears-4

Having looked at the ubiquitous 741 device in the previous articles, this month the author discusses some of the many other operational amplifier ICs which are used. These include the earlier 709 device, and later devices such as the LM308. The technique of frequency compensation is described, and slew rate limiting explained.

by J. BRIAN DANCE, M.SC

In the previous articles in this series we have discussed only circuits based on the 741 device, because it is very cheap and readily available; in addition, the use of a single device type for many circuits minimises equipment costs. In this article we will first look at some of the other early devices, since this will enable us to understand some important points about integrated circuit operational amplifiers which we have so far omitted for simplicity. We will then consider some of the more recent devices to ascertain in what ways their performance is better than that of the 741. There is such a proliferation of operational amplifier devices available at present from various manufacturers that we shall be able to cover only a small proportion of the vast range; generally we shall select those which are well known or economical.

BRIEF HISTORY

One of the first monolithic operational amplifiers to become available was the 702, in 1965. This was closely followed by the well-known 709, which was introduced as the UA709 by Fairchild in 1965/66. This provided a much higher gain and increased input impedance, and can be fairly described as the first true operational amplifier integrated circuit to be produced in quantity. The 741 followed in 1968. The 702 is no longer used, so we will not discuss this device but will pass straight to the 709 which is still commonly used in the older types of equipment.

THE 709

There are various versions of the 709, but the basic electrical characteristics are all very similar. As in the case of the 741, the 709 is normally operated from balanced power supply lines with voltages up to $\pm 15V$ (the absolute maximum permissible value is $\pm 18V$). The supply current with $\pm 15V$ lines is typically 2.6mA (maximum about 7mA), as opposed to the 1.7mA typical for the 741. The voltage gain may be rather less that that of the 741, the minimum being 15,000. The input resistance of about 250 kilohm (minimum 50 kilohm) is less than the 1 megohm of the 741. The 709 input current can be as great as 1500nA (typical 300nA) as opposed to the 500nA (typical 200nA) of the 741. Thus the characteristics of the 741 are generally slightly better than those of the 709.

When either a 709 or a 741 is operated from $\pm 15V$ supplies, the output voltage can swing over a range of at least $\pm 12V$ (typical $\pm 14V$), although this range falls by a volt or two at both the positive and negative sides if the load is reduced in value to about 2 kilohm. The maximum positive or negative voltage swing can never exceed the magnitude of the supply line potential, so the maximum output swing decreases as the supply voltage is reduced. As a rough guide one may assume that the output can swing between $\pm 80\%$ of either supply line voltage. The other 20% of the supply voltage

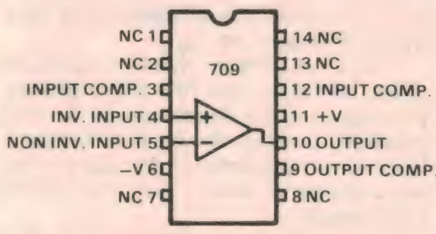


FIG. 25

is required to ensure correct operation of the amplifier device circuitry.

The 709 is available in a dual-in-line package with the connections shown in Fig. 25, but can also be obtained in circular metal packages. One can see from Fig. 1 that this device has similar non-inverting (+) and inverting (−) inputs to the 741, but one notices the absence of offset nulling facilities.

FREQUENCY COMPENSATION

As the input frequency to any operational amplifier rises, there will be phase changes between the input and output signals, and at some high frequency this can result in the feedback becoming positive and hence causing oscillation. In the 741 this is prevented by the use of a 30pF capacitor formed inside the device on the silicon chip, which reduces the gain at high frequencies.

The 709 does not include such an internal capacitor and therefore "frequency compensating" capacitors must be connected in the external circuit to the "compensation" terminals. The circuit of a 709 inverting amplifier is shown in Fig. 26 and may be compared with the 741 inverting amplifier of Fig. 9 (part 2).

The components C1 and R3 provide frequency compensation in the input circuit, whilst C2 provides similar compensation in the output circuit of the 709. The input and output frequency compensation terminals are sometimes labelled "input lag" and "output lag" respectively owing to the phase change they produce.

The external compensating capacitors required in 709 circuits do complicate the circuits, but one does have the advantage that the high frequency response can be altered by a suitable choice of these component values. In particular, their optimum values vary with the circuit gain if one requires maximum bandwidth with good stability. If, for example, C1 = 500pF, R3 = 1.5 kilohm and C2 = 20pF in Fig. 26, the 709 will provide a bandwidth of about 700kHz at a gain of 10

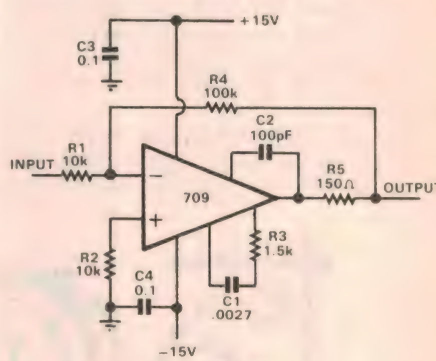


FIG. 26

with the values of R4 and R1 shown. In contrast the bandwidth of a similar 741 circuit with a gain of 10 is only about 100kHz.

This difference becomes still more pronounced at higher values of gain. For example, if R4 is increased to 1 megohm and R1 reduced to 1 kilohm to obtain a voltage gain of 1000, one can achieve a bandwidth of around 300kHz if R3 = 0, C1 = 10pF and C2 = 3pF; this may be compared with the 1kHz bandwidth of a 741 circuit at a gain of 1000.

This shows that the 709 can give a far greater bandwidth than the 741 when both are operated at high gain, provided

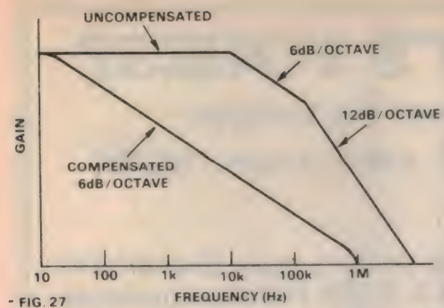


FIG. 27

that one takes the trouble to choose appropriate values of the frequncy compensating components. However, if the gain of a high gain, large bandwidth 709 circuit is reduced, the values of the compensating capacitors must be increased for stability at high frequencies.

Fig. 27 shows how the gain of compensated and uncompensated operational amplifiers varies with frequency. The gain of an uncompensated amplifier starts to fall at 6dB per octave at a certain frequency, 12 dB per octave at a higher frequency and perhaps 18dB per octave at a still higher frequency. Compensation involves rolling off the gain from quite low frequencies at a constant 6dB per octave right up to the point at which the gain is unity.

If the frequency at which the 6dB per octave compensation roll off commences is fixed at too low a value, this will result in a reduced bandwidth, whilst setting it at too high a frequency will result in oscillation (or at least high frequency peaking and overshoot) when the device is used with the normal negative feedback. If, however, a wide bandwidth is not required, additional stability may be obtained in the case of poor circuit layouts if the roll off commences at lower frequencies.

709/741 COMPARISON

As in the case of the 741 circuit of Fig. 9 (part 2), the voltage gain of the Fig. 26 circuit is equal to R4/R1, or 10 (20dB) with the component válues shown. The value of R2 is made approximately equal to the inverting input circuit impedance in order to minimise the output offset voltage due to current flow through the input circuit resistors.

The 741 contains circuitry which limits the output current to about 25mA and no damage will occur if the output is shorted to either power supply line for an indefinite time. The 709 does not contain such a protective circuit and if the output is shorted to a supply line or to ground for a period exceeding a few seconds, the device may be damaged. The output impedance of the device is about 150 ohm, but an additional resistor may be included in the output circuit to limit the output current somewhat in the event of accidental shorting.

The internal circuit of the 741 is designed so that the device will not "latch up". On the other hand, a high or low input voltage applied to a 709 can cause the output to "latch up", in which case the ouput potential does not return to its normal value when the input voltage is removed.

The input voltage to a 741 device should always have a value in between that of the two supply lines with a maximum range of ±15V. The input voltage to a 709 is somewhat more limited, namely a maximum of ±10, whilst the voltage difference between the two inputs should not exceed 5V. The 709 is more likely to oscillate than the 741 if the power supply decoupling capacitors are omitted.

The emitters of the internal output transistors of a 709 are connected directly together to form the output, whereas bias is applied to the output transistors of a 741 to bring them into Class AB operation. This reduces crossover distortion, but in any case negative feedback reduces distortion.

There are minor differences in the specifications of various 709 device types. For example, the typical 709A and 709C input currents are both 100nA, but their maximum values are 200nA and 500nA respectively. Similarly, the 709A 'premium' device has a smaller input offset voltage than the 709C. Various devices like the 709 are available; for example, the MC1437 and MC1537 each consist of two 799-like devices in a single 14 pin dual-in-line package.

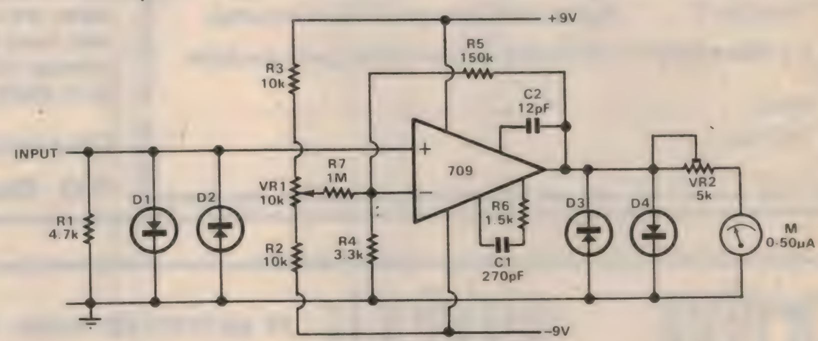


FIG. 28

709 MICROAMMETER

The circuit of Fig. 28 shows how a 709 device can be used to produce a full scale deflection of a meter with an input current of 1uA. The 709 does not have offset nulling facilities and therefore a variable bias must be obtained from VR1 for setting the zero of the meter. The sensitivity is set by VR2.

All of the four diodes in the circuit of Fig. 28 may be 1N914 or 1N4148 silicon types. The diodes D1 and D2 protect the input of the device against any excessive voltage, whilst the diodes D3 and D4 will prevent any excessive voltage being developed across the meter.

An input current of 1uA flowing through R1 will produce about 4.7mV at the non-inverting input. The gain of the circuit, R5/R4, is about 45, so the input current produces an output voltage of about 210mV. This will drive a current of 50uA through VR2 and the meter when the total resistance of these components is somewhat less than 5 kilohm.

The components R6 and C1 provide input frequency compensation, whilst C2 provides output compensation. Somewhat similar circuits using a 709 device can also be used to make a millivoltmeter, but R1 of Fig. 28 will not normally be used in this case, since a millivoltmeter should normally have a higher impedance than 4.7 kilohm.

LM101/101A

The LM101 device is designed so that frequency compensation can be effected with a single external capacitor instead of the three components used to provide frequency compensation in the circuits of Figs. 26 and 28. It also incorporates short circuit output protection and will not latch up. It may be regarded as an intermediate device between the 709 and the 741.

The LM101A is like the LM101, but has much lower input currents (typically 30nA at 25°C, maximum 75nA) than any of the devices yet discussed. A cheaper version, the LM301A has a typical input current of 70nA at 25°C (maximum 250nA), this being three times less than that of a typical 741. The input impedance of an LM301A is typically about twice that of a 741, namely 2 megohms. The LM307 (mentioned last month) has input currents similar to the LM301A, but no external frequency compensating components are needed.

THE LM308

The LM108 device developed by National Semiconductor about 1970 employs special transistors, fabricated on the chip, which have a current gain of about 4000. This enables input currents of typically 0.8nA (maximum 2nA) to be obtained with an input impedance of about 70 megohms. A more economical version of this device, the LM308, has input currents of about 1.5nA (maximum 7nA) and a typical input resistance of 40 megohms (minimum 10 megohms). Thus these devices have input currents well over one hundred times less than that of the 709, whilst the relatively economical LM308 costs about 2½ times that of a 709.

The typical supply current required by the LM108, LM208 and LM308 is only 300uA (maximum 800uA), the supply vol-

Op-Amps without tears

tage range being ±2V to ±15V. Thus it is very suitable for battery powered equipment. A single external capacitor is required for frequency compensation with these devices, whilst the gain without feedback is higher than with most of the earlier devices. The common mode rejection ratio (a measure of the ability of the device to ignore "common mode" signals fed to both inputs simultaneously) is also about 10dB greater than that of a 709 or 741. Unlike the earlier devices, the LM308 has a maximum temperature coefficient of the input offset voltage guaranteed to be no more than 30uV per degree C.

It should be clear from what has already been said that the LM308 series of devices offer many advantages over the earlier types. In particular, the low input current allows these devices to be used in circuits of very high impedance. The offset voltage of the LM709 device is significantly degraded when the input impedances exceed 10 kilohm, but with the LM101A this is increased to about 500 kilohm, whereas the LM108 operates well with input resistances above 10 megohms.

The effect of high input impedance on the drift of an operational amplifier is well illustrated by Fig. 29 which is reproduced from the National Semiconductor application note AN-29 "IC Op Amp Beats Fets on Input Current". The performance of the 709 is degraded by input impedances exceeding 3 kilohm, the LM101A by impedances of over 100 kilohm, whilst the LM108 can give good results at 3 megohms in respect of drift errors.

Various somewhat similar operational amplifiers with very low input currents are available in which "super gain" transistors are employed. For example, the LM308A has the same low input current specifications as the LM308, but the input offset voltage is much lower—typically 0.3mV (maximum 0.5mV) as against the typical 2mV (maximum 7mV) of the LM308. The Motorola MC1456G, MC1456CG and MC1556G are another family of the devices with low input currents, although not quite such low values as the LM308. These Motorola devices are available in T0-99 metal cans, but unlike the LM308 they have offset nulling connections.

Such high input impedance devices are very useful for amplifying the signals from various types of high impedance transducer, such as piezo-electric ceramic or capacitive types. The low input current of the LM308 enables it to be used in analog time delay circuits, for delays of up to an hour with a capacitor of only 1uF in value; this capacitor charges slowly through a resistor and the low input current of the LM308 enables the resistor value to be very high and hence the capacitor to be small for a given time delay.

HIGH IMPEDANCE AMPLIFIER

If one requires an amplifier with an input impedance of 2 megohms and a gain of 100, it might appear that an LM308 used in the general type of circuit shown in Fig. 26 would be suitable. However, the feedback resistor would have to have a value of 200 megohm for a 2 megohm input resistor, and such high value resistors are expensive unless one can accept wide tolerances.

The required resistance can be reduced using the type of circuit shown in Fig. 30. The components R4 and R5 form a potential divider so that only one hundredth of the output signal appears across R5. Thus this fraction of the output is fed back through R2 and a gain of 100 is obtained since R1 and R2 are equal. Thus the only high value resistors required are two 2 megohm components.

The circuit technique used in Fig. 30 does increase the offset voltage by a factor of 200, whereas a conventional circuit with a gain of 100 would increase it by only 101 times. However, if R2 is increased to 20 megohms and R5 to 5,550

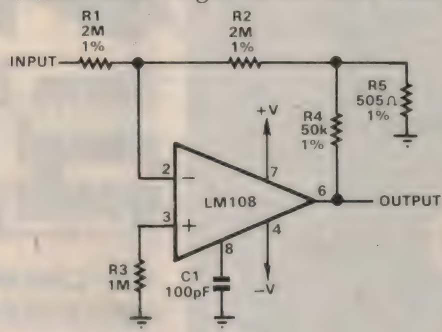


FIG. 30

ohms, the offset voltage is increased by a factor of 110. Another minor disadvantage of the circuit of Fig. 30 is that the gain is determined by the values of four resistors instead of the normal two; 1% resistor tolerances have been suggested in the circuit of Fig. 30 for fairly close tolerance in the gain.

Frequency compensation in LM308 circuits may be achieved in the normal way by connecting a suitable capacitor between pins 1 and 8; the value of this capacitor may be roughly equal to the output capacitance (30pF) divided by the closed loop again. However, the alternative compensation circuit shown in Fig. 30 has the advantage that one obtains a factor of ten improvement in the rejection of power supply noise at the output.

SLEW RATE

The slew rate of an operational amplifier is a measure of the ability of the device to change its output voltage rapidly when the output signal is large. The 709 and 741 devices have slew rates of about 0.5V/us, but much higher slew rates can be obtained using the LM318 (typically 70V/us, minimum 50V/us).

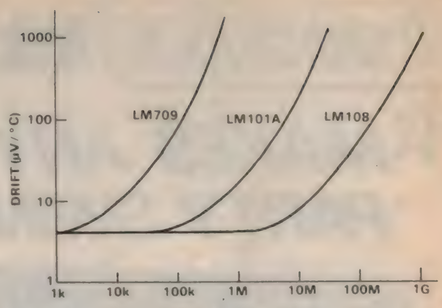


FIG 29

Other more specialised devices can provide slew rates of some hundreds of V/us.

Slew rate and bandwidth are quite distinct properties. If an amplifier has a large bandwidth, but a small slew rate, it will be able to amplify high frequency signals provided that the output signal level is small. However, when the output signal level increases, the output voltage will not be able to change quickly enough in terms of V/us for the output signal to be a faithful replica of the input signal.

MICROPOWER DEVICES, ETC

Some operational amplifiers are designed to operate from a low supply voltage at very low supply current and are especially useful with battery supplies. Power comsumptions of 2uW at ±1V are not uncommon.

Next month we shall consider devices using various types of field effect transistor for really high input impedances.

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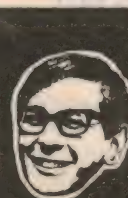

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Forum

Conducted by Neville Williams

A new kind of language problem . . .

As up-to-the-minute electronic types, we may choose to make fun of the legal profession for their involved phraseology, or to point a scornful finger at religionists and others for the way they choose to say things. What we may fail to realise is that we harbour within our ranks many who are so steeped in communications jargon that they seem to have forgotten the equivalent terms in plain English!

If you have any doubts on this score, I suggest you take a little time off to listen to some of the exchanges on the Amateur Radio bands.

Amateurs rarely admit to having a name, at least within their own circles; they are distinguished by "handles" such as Tom, Dick or Harry.

They don't live in homes like other people, nor do they have street addresses; instead, they get by with a "QTH".

A local thunderstorm doesn't cause static in an amateur "rig" as it does in other people's receivers; it produces "QRN".

If the selected channel is carrying more than its share of signals, they don't interfere with the one the amateur is trying to listen to; they merely cause "QRM".

It so happens that QRN and QRM sound alike, when spoken, but that needn't confuse the resourceful amateur. He merely invokes the phonetic alphabet and confirms that he is referring to "QRN—Quebec—Romeo—November". Without that option, he'd have to make do with the "static"!

Amateur Operator's personal arrangements also appear to be rather unusual. They set up house with "XYLs" and, if they can find enough time outside the "shack" to contribute to a pregnancy, the end result is likely to be one or more "harmonics".

One could go on, of course, but you probably catch the idea!

To be fair, some of the abbreviations used by Amateur operators, and the Q-Code in particular, do have a definite role in the scheme of things.

It is much quicker and easier for a CW operator to tap out "QTH" followed by an address, than it is to send: "The address of my station is . . ." Similarly, "QTH?" is can be sent much more rapidly than "What is the address of your station?".

When CW operators are conversing, the use of abbreviations is therefore logical; it speeds up the communication process and allows it to keep pace more effectively with the operators' thought processes.

It also opens up another possibility, in that abbreviations and the Q-code symbols are recognised internationally, making it possible for CW operators to exchange information without either of them understanding the other's language or inflections.

Abbreviations are logical, too, in the world of teletype—a matter underlined for the writer by the recent activities of Jim Rowe and David Edwards. Why send PLEASE when PSE will do? or TEMPERATURE when you can get by with TEMP? And so on.

Where logic tends to go out the window is when abbreviations and Q-code symbols are substituted for ordinary words and phrases in spoken conversations between amateurs who speak the same language and who may even live in the same town.

What represents an economy in code form may be just the reverse when expressed as spoken syllables. In any case, the Amateur who goes on the air for a chat (or "mag" or "ragchew") is, per se, not particularly concerned to save words. He may need them to bulk out a reasonable "over"!

At a normal social gathering, an amateur will introduce his spouse as "my wife"; but over the air, or at an amateur meet, she becomes "the XYL"—four syllables instead of two and, by inference, part of the station equipment. Name (one syllable) becomes "handle" (two syllables); home (one syllable) becomes "QTH" (three); kids or children become "harmonics" and so on.

What's more, the pressure to conform becomes very noticeable the moment you press the "talk" switch. Try it, if you haven't, and see what I mean.

Talk in terms of your name, your home address, your wife, family, static, interference, acknowledgment of transmission, etc., and you feel about as comfortable as someone who turns up to a barbecue in evening dress. You must be either naive, or an exhibitionist!

With the recent arrival of the CBer, the sentiment was often expressed that they didn't want to get involved in the formalities and jargon of amateur radio. But, in very short order, their determined efforts not to conform have led them to a uniform non-conformity such that one can pick the CBers from the amateurs long before the announcement of a callsign, or lack of it!

It's the lounge suit and blue denim situation all over again.

CBers don't use formal callsigns (they can't, as yet) but they invent their own informal ones which range all the way from complicated alpha-numerics to "Big Boobs".

To acknowledge receipt of information, CBers studiously avoid the traditional "Roger" (two syllables) but substitute on "10-4" (two syllables).

They never aggree wholeheartedly with a proposition; instead, they endorse it with; "a big fat 10-4 to that one!" Or something to that effect.

They never disagree or say "no"; it's much more likely to come out as: "negative, repeat, negative on the . . ."

And, at the end of transmission, it's quite infra-dig for a CBer to say "Over"; that's what professional and licenced amateur operators say. CBers have substituted "Come on"—the same number of syllables and somewhat harder to say.

However, while making these points, by way of comment I should stress that I'm not getting up-tight about the situation. As evidence of this, elsewhere in the issue, you'll find a data sheet which is intended to help you to at least understand the jargon, whether or not you want to use it personally.

Rather like the foreign phrases sheets that are offered to tourists!

But, as I said at the outset, don't let's be too ready to criticise others—legal eagles for their wherefores and "hereinafters", or the clergy for their "thees" and "thous". One of these days, as you farewell the parson at the church door, you may well come out with:

"A big 10-4 on that over" or

"When'll we see you at home-20?" To which he may retort:

"73's OM. I'll catch up with you further down the log".

COPYRIGHT, AND ALL THAT

Now to change the subject:

The letter reproduced herewith from the Department of Education, Sydney, is more or less self-explanatory and we present it partly to set the record straight, and partly because it opens up various

questions which readers put to us from time to time about copyright, with royalties and patents thrown in for good measure.

The subject of copyright is extremely complicated, and is one which has supported whole generations of the legal fraternity in the manner to which they have been accustomed. I can only comment here in the very broadest of terms.

By and large, one cannot copyright basic information such as that mentioned in the letter, although one may claim copyright over the way in which it is presented—provided, of course, that the presentation is unique and original.

The difficulty of establishing copyright over information, as such, is not hard to deduce. In the case in point, the NSW Education Department would have to establish that their conclusions about how a multiple-choice examination should be designed were absolutely original and had not been anticipated, in whole or in part, by any previously published research.

In the unlikely event that they were able to establish such a claim and, further, were able to copyright the basic information, then instructions about the conduct of multiple-choice examinations, and indeed the very conduct of all such exams in conformity with the particular guidelines, would have to be by courtesy of the NSW Education Department—a rather preposterous proposition.

In fact, the acquisition of information and knowledge is a continuing and progressive process. We observe, we listen, we read, we discuss, we experiment and we ponder, ultimately reaching conclusions which, for all their supposed originality, owe an enormous debt to what we have absorbed from others.

It is really quite difficult to identify a conclusion as original, and even more so to be sure that it is unique.

In common with any number of other publications, every issue of "Electronics Australia" is crammed with information—most of it drawn from a pool of specialist knowledge—but sorted, organised and displayed in a way which will hopefully attract and inform readers.

And this is where copyright really flows from: the initiative, the creativity and the effort to present the information in a particular way—photographs which we have taken or brought, drawings which we have especially prepared, text which we have especially written.

Another publisher may well cover the same subject, draw on similar information sources, come up with a very similar

Dear Sir,

Neville Williams' FORUM (photocopy attached) in the June 1976 issue of your magazine generated considerable interest within our office. We felt the examination question analyses were well presented and the points well made. It seems a pity that the questions had not been subjected to the same detailed scrutiny before the examination paper was ever printed.

Since 1974 This Unit has been concerned to improve the standard of objective testing in New South Wales schools. At last we have some indication, in the panel ascribed to Keith Howard "a professional educator", that our message is getting through.

On comparing "Keith Howard's summary of the requirements for a multiple choice type of examination paper" with the attached Workshop Manual (pages 3, 4, 5, 11, 12, 13), you will see the reason for our interest. The copyright statement inside the back cover of the Manual was not meant to prevent reproduction of the contents (we are, after all, in the business of spreading the message), but we would have appreciated a note, or even a phone call from Mr. Howard to clear his use of Crown Copyright material. The Manual is undated, but was printed in 1974 for use in Education Department test item writing workshops. It is likely to be revised and reprinted in the near future.

I MUNRO
(Chief Services Officer,
School Certificate Development Unit.)

FORUM—continued

presentation—and justly claim copyright over his particular photographs, his drawings and his text.

As we observed earlier, the NSW Education Department can scarcely claim copyright on the basic concepts of how a multiple-choice examination should or should not be conducted. They may, however, claim copyright on the text—the actual sequence of words, sentences and paragraphs—which a staff member presumably wrote and caused to be published.

Reduced to essentials, the substance of Mr Munro's complaint is that Keith Howard's summary of the requirements for a multiple choice type of examination paper strings together phrases which are identical to phrases in their manual.

In defence, our contributor might claim that in obviating irrelevant or redundant material, he has produced a new document, which expresses the pertinent (non copyright) information in a better way, the similarity of the contested phrases being of no consequence. Had it been deemed necessary, he could have used other common phrases or constructions to convey exactly the same information, presumably then without challenge.

Fortunately, the Education Department is not seeking to do more than secure some belated recognition for their work and initiatives in this area, and I find this completely understandable. I can't speak for Keith Howard of course but, had we been aware of the Department's publication at the time of printing, we would almost certainly have followed our normal course and slipped in some acknowledgement of it, as well as of Keith Howard's personally devised summary.

After all, acknowledgement of an information source is not only a courtesy, it tends also to add a dimension to what is being said.

That point aside, it was good to have the endorsement of the NSW Education Department on a controversial matter.

As publishers, we have to be constantly alert in the area of copyright although, fortunately, the relationship between technical magazines is not nearly as trigger-prone as that between magazines in the general field, or between daily newspapers. Even so, part of our job every month is to determine what items are freely available for publication, what are subject to written permission and what have to be bought—at what price from whom.

There are traps, such as the one which showed up while this article was being prepared, in the form of a quite clever design for a particular piece of equipment. It was the kind of article which we might easily have tidied up and published over the correspondent's name, paying him a publication fee to confirm our rights to the words and diagram as finally printed.

However, a member of our staff who handled the letter, was alerted by a couple of suspect statements and, on a hunch checked through past correspondence files. It transpired that the contributor was a relative beginner who could not possibly have designed the equipment in question, even though he may have built it from somebody else's circuit.

We would have had rather red faces if we had published a design and ascribed it to a particular contributor, only to learn that he had copied it from another magazine or from a manufacturer's manual.

As far as our own designs are concerned, we do not seek, at present, to maintain any copyright on the basic information or the basic designs. Readers are free to use them in any way they like—one-off copies, kits, or a production run.

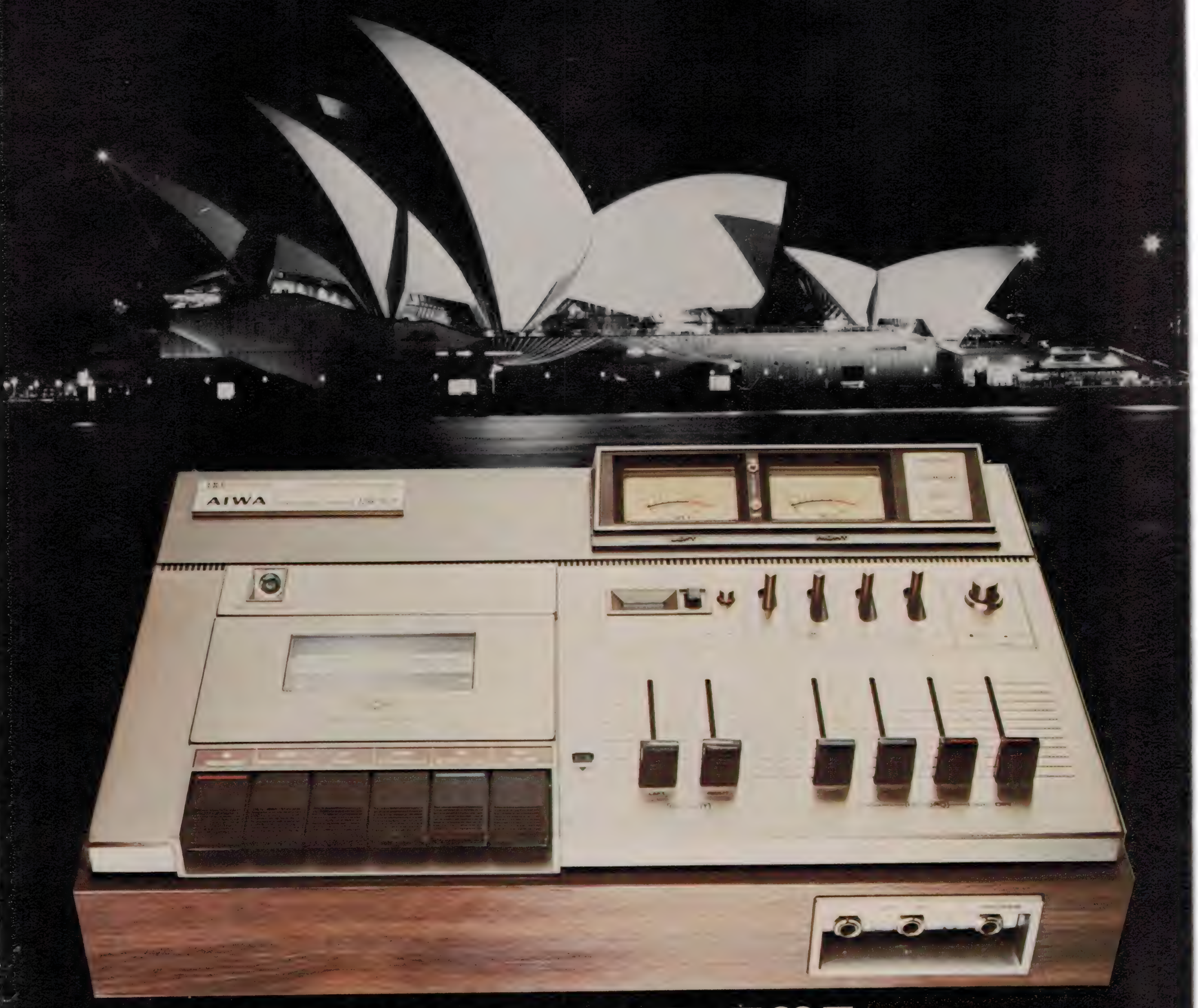
What we do regard as copyright is our essential stock-in-trade—the actual text of the article, the actual circuits and pictures, and the title by which the project is known and identified with "Electronics Australia". Technically, this printed material should not be reproduced without permission and, while we may have to tolerate single photostat copies by individuals, multiple copying and multiple distribution without permission is a clear breach of copyright.

As far as project names are concerned, we allow these to be used to identify kits and built-up copies but only on the understanding that the kit or product conforms substantially to the published design. If someone wants to market a kit or product which is a variant of the published design, we require that it be given its own name or offered as one "based on" the particular E.A. project. As such, it may be better than the original, or it may be worse; but the revised design is the responsibility of the organisation concerned.

One other point, which is mentioned on page 3 of each issue, has to do with patents, rather than copyright. Projects and circuits described on "Electronics Australia" may involve patents in force in Australia and elsewhere. As a magazine concerned only with the dissemination of information, we are free to publish devices and circuits which may be patented.

In practical terms, individuals can make up one-off copies for their own instruction and diversion, and again in practical terms, patent holders seldom find it worthwhile to concern themselves with someone who makes up a few kits or a few projects for sale unless, of course, they are high value items.

However, if an individual or a company decides to manufacture one of our projects on a large scale, he (or the company) is in no different position from any company who decides to manufacture and market any product; they have to consider their patent obligations and logically consult an expert in that field.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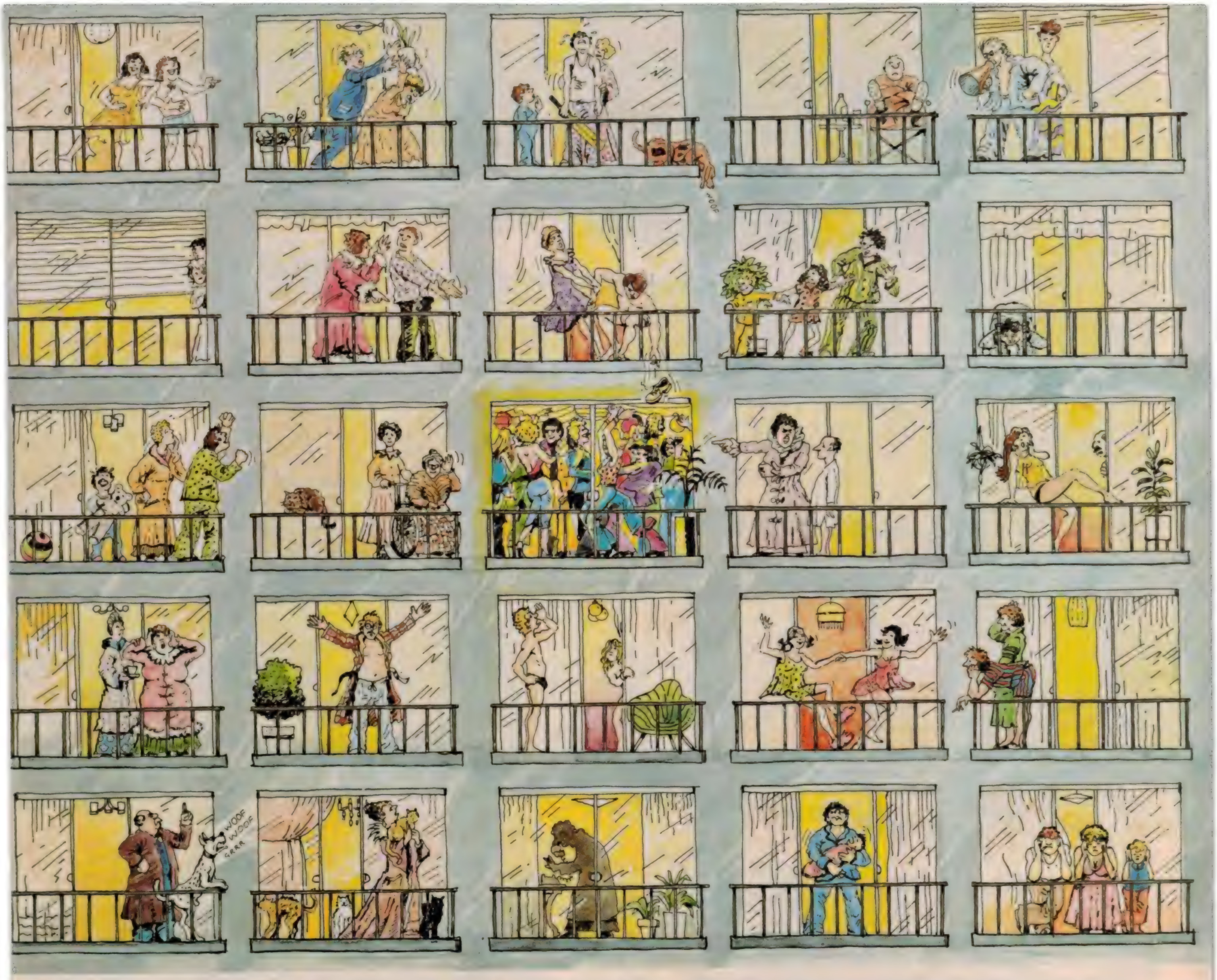

or your neighbours.

At some stage in their hi-fi lives most buffs invariably want to upgrade their equipment for something with a little more oomph.

And this, we readily admit, more often than not turns into a rather expensive exercise.

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As well as giving you low distortion over a wide range of frequencies.

In fact over thirty-five years of continual thinking and making have gone into the perfecting of La Scala's. And yet even with today's high technical standards few have been able to come near us in such terms of power excellence. So as you can see they're not an overnight pop phenomenon.

(We also think so much of our speakers that under normal usage we even give a lifetime guarantee.)

No doubt the only way to really appreciate just how good La Scala's are is to pay a visit to one of our dealers listed overleaf and purchase a pair.

If you're still not totally convinced once having installed them, we have one other sure fire way of testing them.

Turn up your amplifier and ask your neighbours.

Klipsch

Electronics in the classroom

As this issue was prepared for publication before the start of the school year, it was too early for teachers and students to have encountered problems with new school electronics course. However, to start the ball rolling, we present below the answers to some of the questions we think may arise in many typical situations.

Q: Some of the simple projects which have been published in school electronics courses call for high impedance earphones—say 2000 ohms. We've found these very hard to obtain. Is there any way of using the more readily available 8 ohm type?

A: Yes, there is. Probably the easiest way is to use a matching transformer. Strictly the transformer should have a primary turns-to-secondary turns ratio of around 16:1 to produce an effective 2000 ohm load from a single 8 ohm earphone, or around 11:1 if you wire two earpieces of a headset in series first, to give 16 ohms.

Most circuits which call for a 2000 ohm earphone aren't all that critical, though, so you could probably use almost any old output coupling transformer from a discarded valve or transistor radio. Those from a transistor radio will probably tend to have too low a turns ratio, while those from valve sets will tend to have too high a ratio. So you may have to experiment with a few in order to get good results.

In a pinch, you may even be able to use a small mains stepdown transformer —say one designed to step 240V down to 12 or 15 volts. These tend to be rather poor in terms of frequency response, but they can give reasonable results in some circuits.

Note that the earphone or earphones should be connected to the low impedance winding of the transformer, which will become the secondary (even if it wasn't originally), while the high impedance winding is connected into the circuit where high impedance 'phones would normally go.

Q: How about speakers? A number of the projects call for small speakers—say 75 or 125mm in diameter. We have on hand quite a few old speakers of large diameter. Could these be used instead without degrading the performance?

A: In most cases, larger speakers can be used in place of smaller ones without any other changes. And the performance may well be significantly better, as larger speakers tend to be more efficient. Probably the main reason why the projects call for small speakers is that they assume you will be buying them new, and are trying to minimise cost.

Q: When I built up a few valve-type radios in my youth, one used a 40-watt or 60-watt mains type soldering iron and took no special precautions apart from making a good joint without overheating the various parts. But now, my students tell me, one has to take all sorts of special precautions when soldering in transistors and other new components. What's the story?

A: Broadly speaking, large mains-type irons have fallen out of favour, mainly because they tend to be rather unwieldy when you are soldering small components. High power irons also tend to overheat small parts, unless you take great care.

For soldering in circuits using most so-called "discrete" components—like normal transistors, diodes, resistors and capacitors—it is usually quite sufficient to simply use a small low-voltage iron of around 10-20 watts. Ideally the iron should be earthed, but apart from this no other precautions need be taken.

This is also true when you are working with circuits using integrated circuits of the TTL or older RTL type.

The only time additional precautions need be taken is when you are working with circuits using MOS transistors, either in discrete form or in MOS integrated circuits.

For these circuits, the main additional precaution to take is to connect the bit and barrel of the iron to the main supply lines of the circuit, so that no potential difference can exist between the iron and the circuit as a whole.

Apart from this, it is a good idea to wire in the MOS devices last, leaving them in their conductive plastic foam or metal foil until the rest of the circuit has been wired.

It is also a good idea when soldering MOS ICs into circuit to solder the supply pins first, so that any internal protection diodes are able to function as soon as possible.

"Electronics in the Classroom" is a feature to help school students and teachers with any problems arising from school electronics courses. If you have a problem you would like answered in the magazine, send it to Electronics Classroom, c/o Electronics Australia, PO Box 163 Beaconsfield, NSW 2014. We regret that we cannot answer your queries by mail.

The Serviceman

A fault not in the textbook

One of the most useful roles for this column each month is to report the unusual fault; the fault which does not appear in the textbook and, sometimes, not immediately in manufacturer's service notes. My main story this month should have no difficulty in qualifying for that category.

One of the early problems with monochrome TV sets was a tendency to generate a 15,625Hz whistle in the line output transformer. This was due basically to magnetostrictive effects in the transformers core, but was often aggravated by loose hardware associated with it, or in the immediate vicinity.

The seriousness of the problem varied from brand to brand, and even from set to set. It also varied from owner to owner, depending on their auditory acuity. Older male members of the household were often quite unaware of the problem while the younger ones, and particularly the ladies, often found it unbearable.

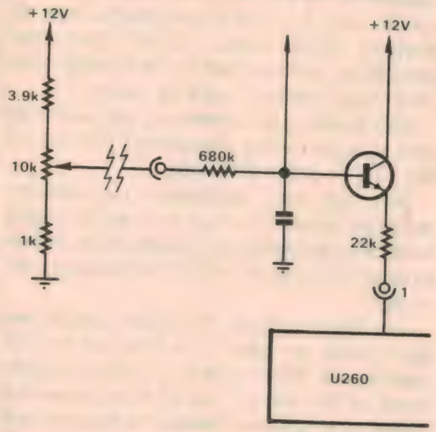
Salesmen were often hard pressed to solve this problem and more than once they were forced to switch brands in order to placate the customer. Another trick I heard about was to appeal to the customer's vanity. The ladies, in particular, could sometimes be talked out of their complaint by complimenting them on their acute hearing and making subtle references to the fact that only young people were normally aware of it! Just how successfully this ploy worked, I have no way of knowing; I never tried it myself.

After the first generation of monochrome sets, little was heard of the problem. Manufacturers sorted out those line output transformers which had proved themselves and these became the favoured group. The others faded into history.

It was something of a surprise, therefore, when the same problem raised its ugly head in a brand new colour set, of well known local make, which I had recently sold to a customer. And, while it was the man of the house who complained to me, he admitted that he could not hear it. But his wife and family were finding it impossible to live with.

Having confirmed, with my ear hard against the back of the set, that there did seem to be a whistle, I decided to take the set back to the shop. I reasoned that, whatever the cause, it would most likely involve a fair amount of mechanical work to fix it, quite apart from the problem of identifying it.

Back at the shop I removed the back of the set, swung out the hinged printed boards, and switched on. Yes, I could still detect a faint whistle and, as far as my tired old ears could determine, it seemed to be coming from the picture tube.



Basic contrast control circuit. Although a simple fault it needed a step by step check to track it down.

While such an idea seemed ridiculous, the more I listened and checked the more convinced I became that it was true. Finally, to avoid wasting any more time, I rang one of my contacts at the firm's service department and, somewhat diffidently, put my suspicions to him.

Somewhat to my relief he did not suggest that I consult a psychiatrist. he didn't even laugh—at least not derisively. But he did chuckle sympathetically. More importantly he confirmed that the whistle could well be coming from the picture tube and that they had already experienced a few such cases.

He went on to explain that it was due to the guns vibrating at line frequency, presumably activated by energy from the yoke.

What to do about it? There was only one solution; replace the picture tube. And while that sounds drastic, at least the picture tube was still under warranty, so the customer would be spared any expense on that score. There was still the time and effort involved in changing the tube but, since the set was also under warranty, the makers picked up the tab for this part of the operation.

From subsequent enquiries I learned that there had been a number of such cases, the first one involving the service department of the set manufacturer. This, in fact, proved to be a very difficult job, partly because it was a new type of fault, but mainly because it chose to behave intermittently. It required about three visits to the customer's home before the technician even observed the fault, after which he had to work out why it was happening.

I also understand that the trouble was traced to one batch of tubes and that, apart from any of that batch which may still be in the field, the problem is unlikely to occur again. Even so, it is worth keeping the fault in mind, just in case.

For those readers who have not yet had the need to change a colour tube the following points may be helpful.

Before attempting to remove the tube make sure the final anode is completely discharged by connecting it to the aquadag coating. Some sets have an in-built wand for this purpose.

Alternatively, it is worth salvaging an EHT connector from a discarded tripler and fabricate a discharge and shorting device which can be left in place while the tube is being handled. Also, keep clear of the EHT lead in the set itself; some tripler circuits can store enough energy to deliver a nasty wallop.

Before removing the yoke, spend a few minutes to make sure you know how the yoke should be removed. Pay particular attention to the position of the convergence coils; make a sketch if necessary. This can save a lot of time when re-fitting the yoke to the new tube.

Some sets have rather flimsy wiring harnesses, particularly where they join the connecting plugs, which can quite easily be damaged while changing the tube. Make sure you have a record of such connections, either in the manufacturer's data sheets or in the form of a sketch.

After fitting a new tube the convergence will most likely be completely out and necessitate a full convergence adjustment. But a word of warning. In the case I have just described the set converged quite normally and produced a first class picture but, within a couple of days the customer phoned to say that the picture was very poor. One glance was sufficient to show that the convergence had

drifted quite badly.

A few quick adjustments restored it to normal but I took the precaution of checking again about a week later. Sure enough, the convergence had drifted again, though not as much as before. I reset it again, then checked with the customer about a fortnight later. This time everything was in order, so I am hoping it will stay that way.

So far, I have not been able to determine whether this was an isolated incident, or whether it is likely to happen with any new tube. But it would seem to be a wise precaution to follow up any new tube installations, just in case.

Some jobs which look as though they could be curly, often turn out to be surprisingly simple. A recent case involved a Philips K9 chassis about which the customer complained of poor contrast.

In fact, it turned out that there was no contrast control action at all. The easiest thing to try was replacing the U260 chrominance/luminance module, but this had no effect. Since this was the last set on my morning rounds, and quite close to the shop, I decided it would be easier to take it with me than work in the customer's lounge room. I promised to try to get it back to him later in the day.

This set uses a BC148c transistor in the contrast control circuit, the base connecting to the contrast control and the emitter to the U260 module. My first check was the collector voltage, which seemed about normal, but there was no voltage on either the base or the emitter.

The contrast control pot (10k) is part of a voltage divider network between the 12V rail and chassis, so there should have been some voltage at the base. I checked the same circuit where the leads from the pot join the printed board, but again no joy.

The next check point was on the convergence board where the pot was mounted; more specifically where the lead from the luminance board joined the convergence board. Here I found voltage, and an ohm meter check confirmed an open circuit lead.

A gentle tug on the lead revealed a dry joint at the contrast control end. The cure was simple; a little cleaning, some solder and a hot iron, and I was able to keep my promise and return the set that afternoon.

A simple job? Well, yes it was, though the symptoms could well have covered a wide range of faults. But it is "silly" faults like these that make up a significant proportion of colour TV faults to date. So the moral is: don't panic—it mightn't be as bad as you imagine.

In lighter vein here is a story demonstrating just how misinformed some people are in regard to domestic appliances. The story started when a young chap purchased one of the now popular three-in-one stereo music centres; AM/FM radio, record changer, stereo tape deck etc. He explained at the time that he was buying it as a birthday present for "Mum". A quick run through on the operation of the unit indicated that he was well versed in such things and should have no problems.

I was rather surprised, therefore, when I received a phone call from "Mum" a few days later saying that the cassette deck was not behaving properly, and would I call and have a look at it.

I took a prerecorded cassette with me and slipped it into the machine. It worked immediately. I turned a questioning glance towards the lady. "Wait a minute," she said, "watch what happens when it comes to the end."

I waited. Fortunately it was a test tape and relatively short. When it came to the end it switched itself off, as it was designed to do. Before I could speak the lady cried triumphantly, "There you are, it doesn't play the other side—it just stops."

Very patiently I demonstrated how the deck functioned and how the cassette needed to be turned over to play the other side. She seemed to take it all in, but I had the feeling that she was not completely satisfied. Finally she blurted out, "But shouldn't the cassette turn itself over?"

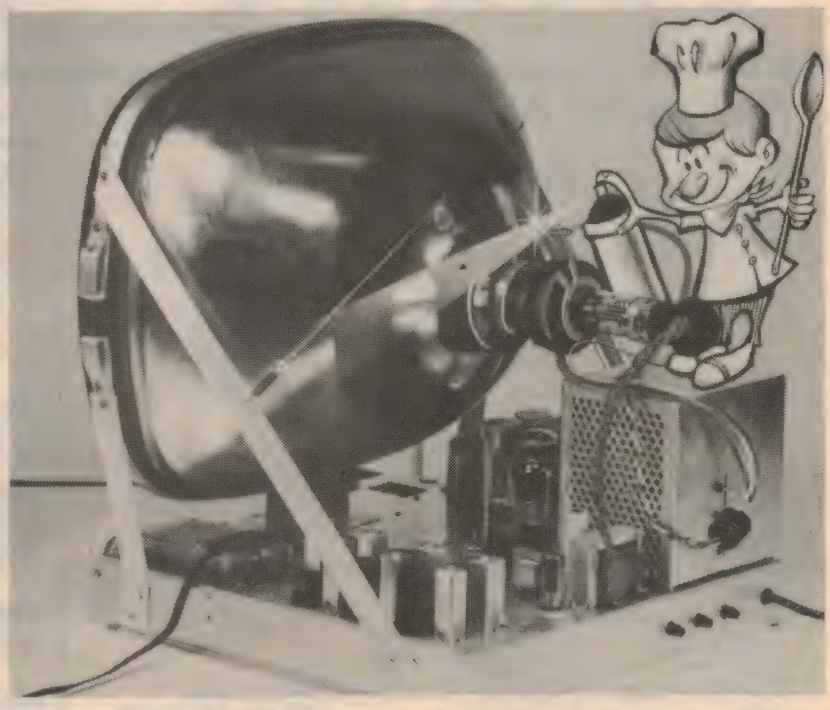
Years of practice have taught me how to keep a straight face in such situations, but I needed all my self-control to cope with this one.

A PURE AND SIMPLE SOLUTION

The following story was related to me by a friend who, while not a serviceman, is actively engaged in the electronics field. As an emergency measure it may well be worth remembering.

On a recent weekend visit to relatives in the central tablelands of NSW, I was settling down to a quiet evening when there was an anxious cry from the lounge to the effect that "the TV set is getting ready to explode".

I hurried inside to be greeted by the familiar sound and smell of a very active corona discharge taking place somewhere inside the set. On removing the back one could almost read by the light of the flashover occurring from the ultor connection on the picture tube. The apparent cause was a film of carbon-like material, deposited on the glass of the tube.



A preliminary wipe with a tissue failed to do any good so, knowing that the household held an armoury of shotguns, rifles, etc that needed lubrication and cleaning, I asked if there was any aerosol oil or similar product around the house.

After a few minutes search I was told that they had run out "but would this do?" . . . "this" being a spray can of "Pure and Simple", a product designed for culinary rather than electronic use. In desperation this was tried and to my surprise it worked well, removing the offending film. (This had been caused, I suspect, by the use of a smokey kerosene room heater and the prevailing damp weather.)

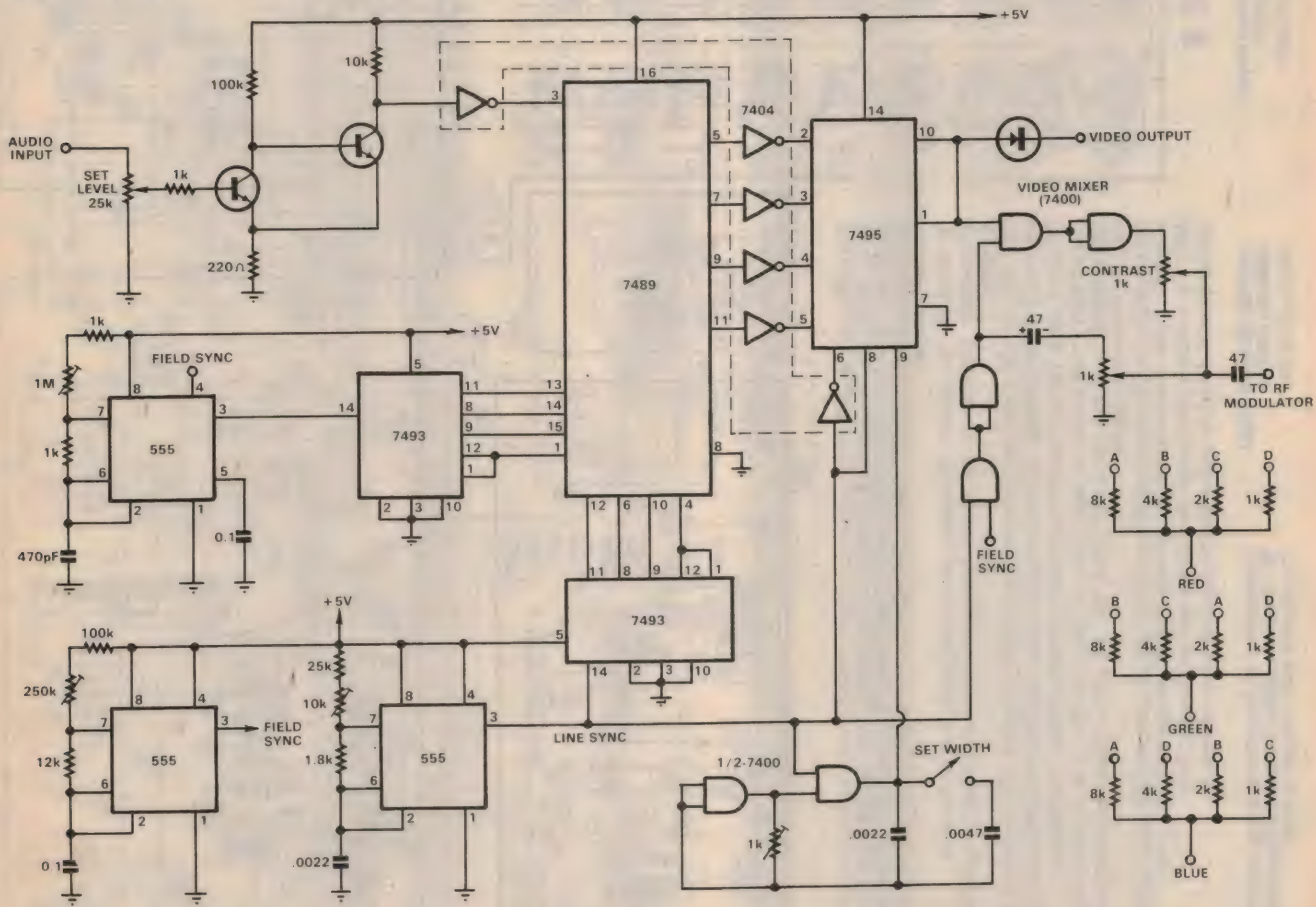
At the time of writing, this cure has lasted for more than two months.

Circuit & Design Ideas

Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Audio-locked video pattern generator



This circuit may be of interest to anyone who has experimented with a music-controlled light display. This system uses randomly generated video patterns instead of the more conventional displays. Music fed into a Schmitt trigger provides a source of pulses which rewrites a line or two of the pattern.

The pattern itself consists of sixteen rows of randomly generated four bit words which are stored in a memory and the pattern repeats continuously to fill the screen. Random numbers are generated by connecting a four bit counter (7493) to count line sync pulses. The outputs from this form the data lines for the memory , and these are sampled at random times by the output from the Schmitt trigger.

The sync pulses could either be generated as shown or taken directly from a TV receiver, as long as it is remembered that pulses must be negative going. The video output can be fed either directly into a TV receiver, or through an RF modulator. If direct connection is intended, some form of buffer amplifier may be required as the video signal is positive going and about 3V peak-to-peak. Note that the video mixer and sync generators can be deleted if the TV receiver sync is used.

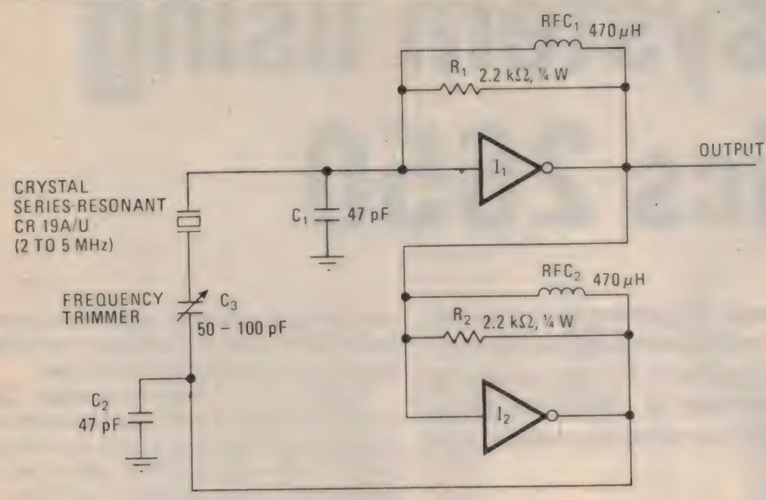
Although the prototype only produces a black and white pattern it could be easily expanded to work in colour. Perhaps the simplest method would be to use each row of the pattern as a BCD number and feed this into a set of appropriately weighted resistors so that the random numbers select random colour levels. To avoid producing a continuously white display the relative weighting between the three colour channels could be varied as shown in the diagrams.

(By Mr Mark Blakey, 19 Stanlake Rise, Lower Templestowe, Victoria. 3107)

Reliable start TTL crystal oscillator

A crystal-stabilised, TTL clock source with no starting problems can be made with two TTL inverters as shown. The circuit has two other advantages. It will operate with almost any crystal and its stability is dependent on the characteristics of only two components.

In the circuit, I1 and I2 are TTL inverters (or NAND gates with the inputs tied



I_1, I_2 = 1/3 OF A 7404 HEX INVERTER, WITH V_{CC} = 5 VOLTS

together) that provide the necessary gain and phase inversion. RFC1 and RFC2 provide DC feedback at the inverters that forces them into a linear mode. These chokes are chosen to provide enough loop gain to drive a weak crystal, and should have a DC resistance of the order of 100 ohms or less. R1 and R2 are Q-swamping resistors inserted to eliminate oscillation of the circuit at the self-resonant frequency of the chokes. If low-Q chokes are used, these resistors may be eliminated, but it is wise to allow for them in the circuit board layout to permit choke substitution.

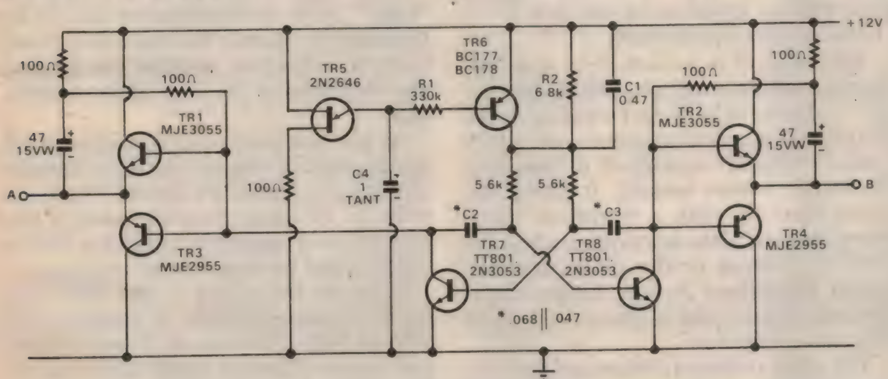
Usually series-mode crystals have three stable modes of oscillation—the one stamped on the can, one above that frequency and one below that frequency. The higher- and lower-frequency modes are generally determined by both the crystal and distributed circuit parameters. Capacitors C1 and C2 are included in the circuit to eliminate these modes—by lowering the impedance of the loop they ensure that the specified frequency occurs. They have very little effect on the operating frequency, so high quality capacitors are not required.

C3 can be a trimmer or a fixed capacitor, depending on the exactness of frequency required. A tuning range of about 100 parts in 10^6 can be obtained by varying C3, but temperature stability and long term stability are dependent on its characteristics.

This circuit with the values shown will operate in the frequency range of 2 to 5MHz. Below this range, the values of RFC1, RFC2, C1 and C2 should be increased. Above this range C1 and C2 should be reduced to 22pF or less

(By Ronald H. Beerbaum, in "Electronics".)

Electronic alarm



The electronic alarm circuit shown was designed for use with a burglar alarm system, but could be used for other functions incorporating a 12V supply. There are three sections, power amplifier, audio oscillator/phase shifter, and frequency modulator.

Power amplification is achieved by a bridge configuration utilising two complementary symmetry amplifiers. As the input to these stages is a square wave no quiescent bias is required. The speakers are placed between points A and B, and will have a signal of 24 volts peak-to-peak developed across them when Q1, Q4 and Q2, Q3 alternately saturate and cut off.

The astable multivibrator Q7, Q8, has an inherent 180 degree phase shift between the collectors and provides the audio signal that can be changed in pitch by altering C2 and C3. Frequency modulation is achieved by changing the astable time constant using Q6 as the controlling element, while R2 and R1 set the maximum range. The rate of variation is determined by the UJT oscillator components R1 and C4 and can best be changed by altering C4 if required.

A power output of about 9 watts can be expected for an 8 ohm load, and about 18 watts in 4 ohms. A horn speaker was used with the prototype.

(By Mr G. T. Ryan, C/— 95 Railway Parade, Norman Park, Qld. 4170.)

A "baby" system using the Signetics 2650

Here is surely the simplest and lowest-cost way of getting to know the Signetics 2650 microprocessor. A complete microcomputer system on a single small PC board, you can build it for around $70, not counting a power supply or terminal. Despite its low cost, it offers the same debug and monitor program in ROM provided by more expensive systems, together with 256 words of RAM.

by JAMIESON ROWE

As we have noted in earlier articles, the Signetics 2650 microprocessor is a particularly powerful device. Its architecture and instruction set are very minicomputer-like, making it well suited for general-purpose computing as well as low-cost dedicated applications.

In their literature, Signetics note that the device may be used to implement a very low cost minimal "evaluation kit" type system, one which would be very suitable for those wishing to gain experience with the 2650 with the minimum outlay of both time and money. However they themselves have not made such a minimal evaluation system available, only larger systems such as the PC1001 and PC1500 systems.

This seemed rather a pity to us, as at least one other microprocessor has been available in a really minimal system, and this has proved very popular. However as the 2650 and its 2608 ROM chip have been in rather short supply until recently, there seemed little hope of being able to remedy the situation as far as the 2650 was concerned.

Happily this situation has now changed for the better. Just a few weeks ago we learned from Philips Industries that the 2650 and 2608 chips were now readily available, and at relatively low cost. (Signetics is a US subsidiary of Philips.) We accordingly suggested to them that this would be an ideal opportunity to produce a low-cost "baby" 2650 system, based on the minimal system suggested by Signetics themselves. They agreed, and offered to make available a set of devices if we cared to try the idea.

This project is the result!

Basically, it is a complete general-purpose microcomputer, just like the larger evaluation kits. In fact it has the same debug and monitor program as the larger kits—"PIPBUG"—resident in the 2608 ROM (1k x 8-bit words). It communicates directly with a standard 20mA asynchronous data terminal, such as an ASR-33 Teletype or the video data terminal described in our January and February issues, and requires a single 5V DC power supply.

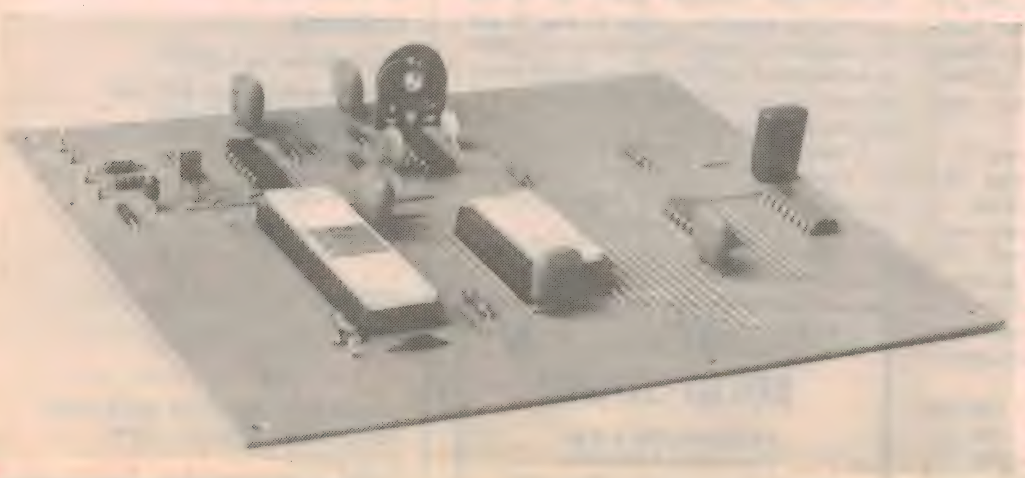
The main difference between this system and the larger systems is that there is only 256 bytes of RAM memory for user program storage, and there is no on-board decoding or buffering for further memory or peripheral expansion.

In short, it is a "bare minimum" 2650 system, designed to be the cheapest and easiest way of getting a 2650 up and running. At the same time, it offers the full program development facilities of PIPBUG, including the ability to examine and alter memory from the terminal keyboard; the ability to dump programs to paper tape or cassette, and then load memory from tape; the ability to examine and set the processor registers; the ability to set and remove up to two breakpoints, for debugging; and the ability to run the user's program on command.

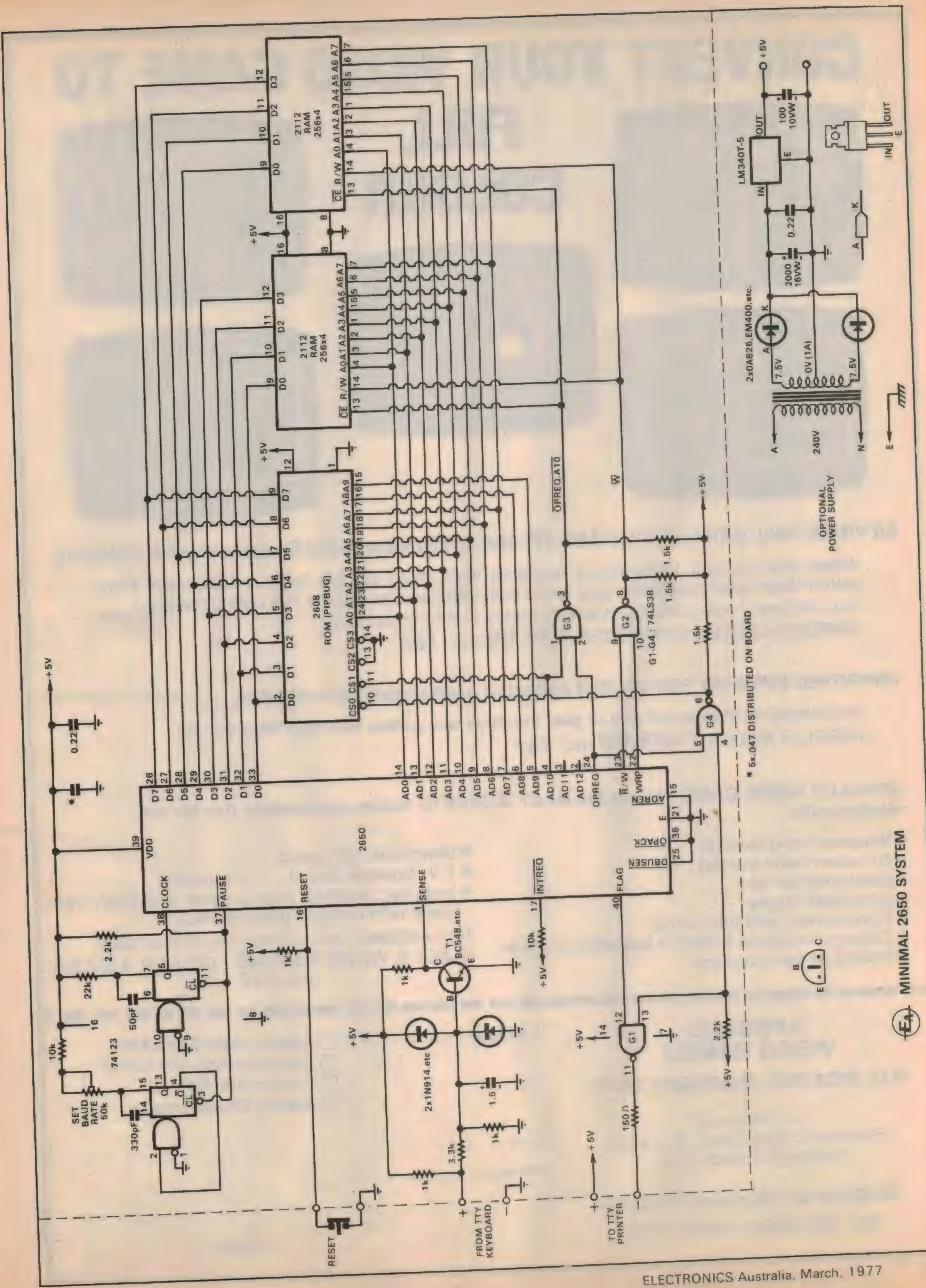
These are quite powerful program development facilities, not usually found on low cost systems. As a result, our "baby" 2650 microcomputer should be particularly suitable for educational and training purposes, whether by schools and colleges or by individual enthusiasts.

As you can see from the diagrams and photograph, it consists of only a handful of parts on a small PC board. There are only six ICs, one transistor and a few resistors and capacitors, and the PCB is single-sided to keep the cost down.

Heart of the circuit is the 2650 chip itself, a powerful 8-bit microprocessor with an instruction set of 75 instructions, and eight different addressing modes. Fabricated using low-threshold ion implantation, it is an N-channel silicon



At left is our new "baby" 2650 microcomputer, complete on its small PC board. It offers the same PIPBUG program in ROM as provided on the larger systems. The full circuit diagram is shown on the facing page, together with an optional power supply.



MINIMAL 2650 SYSTEM

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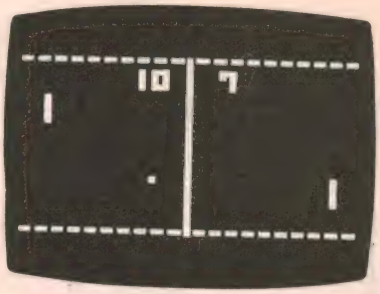

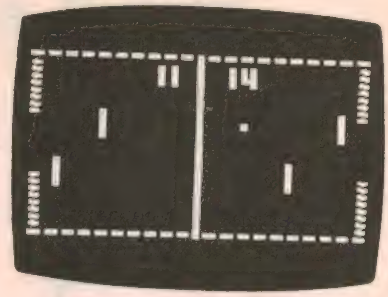

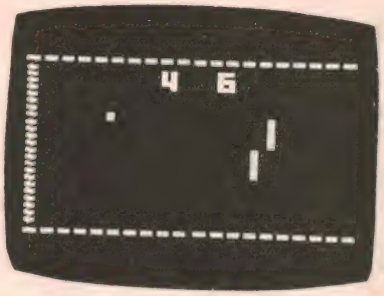

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gate device which operates from a single 5V supply and offers TTL compatibility on all inputs and outputs.

A 74123 dual monostable device is used to generate the single-phase 1MHz clock signals for the 2650. The clock oscillator is of the R-C type, but is easily adjusted to the correct operating frequency without the need for elaborate instruments. More about this later on . . .

As mentioned already, the PIPBUG debug-monitor program is resident in a 2608 ROM. This includes routines for servicing the data terminal input and output, so that the system "knows" how to communicate with a terminal as soon as it is initialised. The code suffix for the 2608 with PIPBUG resident is CN0035.

Two 2112 devices are used to provide the RAM memory of the system. These are low-cost static MOS RAMs, each organised as 256 words or 4 bits, so that the two together provide a RAM of 256 8-bit words. Some 63 words are used by PIPBUG as its scratchpad area, leaving 193 available for user programs.

The remaining IC in the circuit is a 74LS38 low-power Schottky quad NAND buffer, two gates of which are used for simple address decoding to allow the 2650 to differentiate between the ROM and RAM sections of memory.

The ROM is allocated to the address range 000—3FF hexadecimal, or the first 1k of memory space. The RAM memory is allocated to the next 256 bytes of memory space, with hexadecimal addresses 400—4FF. Basically this means that when binary address bit AD10 is 0, the ROM is selected, while when it is 1 the RAM memory is selected.

Gate G3 is used to enable the two 2112 RAM devices when AD10 is at the 1 level. The second input of G3 is fed with the OPREQ signal from the 2650, which is a strobing signal used to indicate when bus information is valid.

When AD10 is at the 0 level, the RAMs are therefore disabled. At the same time the ROM is enabled, because the AD10 signal from the 2650 is also fed to the active-low chip-select input CS1 of the 2608 ROM device. Correct strobing of the ROM is achieved by using gate G4 as an inverter to feed an OPREQ-bar signal to the CSO input of the ROM.

Note that this simple address decoding scheme is not completely unambiguous, because the ROM is enabled whenever AD10 is 0 and the RAMs whenever it is 1. Thus the ROM strictly occupies not only the nominal range of 000-3FF, but also higher ranges such as 800-BFF. Similarly the RAMs occupy not only their nominal range 400-4FF, but also higher ranges such as 500-5FF, 600-6FF, 700-7FF, C00-CFF, D00-DFF, E00-EFF, and F00-FFF.

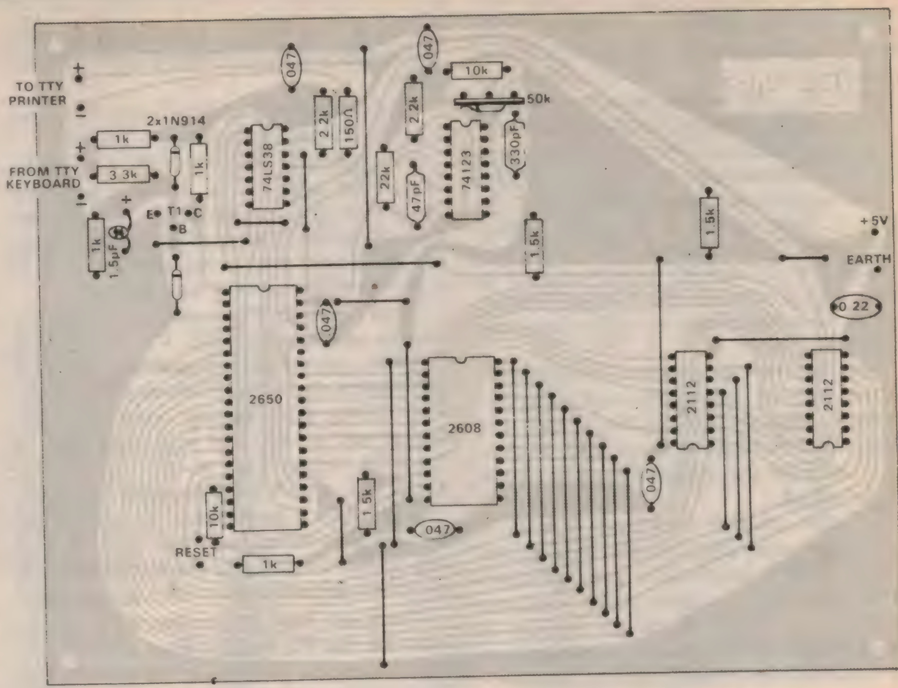
This ambiguity need not cause any complications, however, providing you remember it and take it into account when writing your programs. All it means is that if you forget and your program tries to address these non-existent higher memory locations, it will in reality still be talking to the same ROM and RAMs!

Many small systems use this type of simple address decoding, to simplify the circuitry and reduce costs.

The third gate, G2, is used to control the read-write function selection of the RAM devices. The inputs of the gate are fed from the R-bar/W and WRP outputs of the 2650, while its output goes to the R/W-bar control inputs of the 2112 RAM devices. The R-bar/W output of the 2650 provides its read-write control signal, while the WRP output provides a write strobe pulse designed to delay writing until memory devices have stablised.

The remaining section of the circuit is that used to provide the serial communication ports, which are associated with the flag (F) output and sense (S) input of the 2650. The output port uses the remaining gate G1 as a buffer, to control a 20mA output current in response to the F output of the microprocessor. The 150-ohm resistor in series with the gate output sets the output current level, which is sufficient to drive the normal current-loop input of an ASCII teleprinter or video data terminal.

The input port circuitry uses a BC548 or similar general-purpose NPN transistor T1 to provide level translation between a standard 20mA current loop input and the S input of the microprocessor. The input circuit provides its own 20mA source, and so is suitable for direct connection to the keyboard contacts of a teleprinter, or the corresponding output terminals of a video data terminal such as that described last month.



Using this overlay diagram you should have no problems in fitting the components to the PC board. Sockets are used for the 2650 and 2608 devices.

LIST OF PARTS

1 PC board, 175 x 135mm, code 77up2
8 PCB terminal pins (optional)
1 2650 microprocessor IC
1 2608 ROM (with PIPBUG: code CN0035)
2 2112B RAMs
1 74123 dual monostable
1 74LS38 low-power Schottky buffer
1 BC548 or similar NPN silicon
1 1N914, 1N1418 or similar diodes
1 40-pin IC socket, PC type
1 24-pin IC socket, PC type

RESISTORS

Quarter watt, 5%: 150ohms, 4 x 1k, 3 x 1.5k, 2 x 2.2k, 1 x 3.3k, 2 x 10k, 1 x 22k.
1 47k PC type tab pot, vertical mount

CAPACITORS

1 47pF NPO ceramic
1 330pF NPO ceramic
5 .047uF LV polyester
1 0.22uF LV polyester
1 1.5uF 35VW electro or tantalum
Wire for links, solder, etc.

The 1.5uF capacitor in the base circuit of T1 is to provide contact bounce suppression in the case of teleprinter keyboards, and also to provide filtering of any noise induced in the input line. The two diodes are to protect the transistor from high amplitude noise impulses.

As you can see, the complete baby system is built up on a small PC board measuring 175 x 135mm. The pattern is coded 77up2, and PC boards etched to the pattern should be available from board manufacturers by the time you read this article.

Assembly of the system on the PCB should be fairly straightforward using the overlay diagram as a guide. Note that there are a number of wire links, necessary because the board has been kept single-sided.

In view of the fact that the 2650 microprocessor chip and the 2608 ROM are both fairly expensive, and are both MOS devices, I suggest that you use sockets for them. A 40-pin socket is required for the 2650, and a 24-pin socket for the 2608, both being of the 0.6in row-spacing DIL type. Use high quality sockets if you can, to avoid contact troubles.

The remaining ICs are probably best soldered directly into the PC board.

I suggest that you wire in all of the links first, then add the IC sockets and the resistors and capacitors. Watch the polarity of the 1.5uF tantalum electrolytic, as this could cause malfunction if it is connected the wrong way around.

Now wire in the transistor, the two diodes and the two TTL ICs (74123 and 74LS38), taking care that these are also orientated correctly. Then finally add the two RAMs, after having connected the barrel and bit of your soldering iron to the PCB supply lines to ensure that the MOS ICs won't be damaged by static charge. It is a good idea to solder the supply pins of each IC first (pins 7 and 14), so that the internal protection diodes become operational as soon as possible.

There are only eight external connections to the PC board. Two are for the power supply, which may be almost any reasonably well regulated and filtered 5V DC supply. The total current drain is around 250mA. If you don't have a suitable supply handy, the circuit shown in the small diagram would be quite suitable.

The four connection points adjacent to one another are for the serial input and output. These connect to the teleprinter or video data terminal, with polarities as shown. Whichever type of terminal is used, it should be connected for 20mA, full duplex operation.

The remaining two connections to the PCB go to the reset switch, which is a simple normally-closed pushbutton. When pressed, this button forces the microprocessor to reset its internal registers. Then when the button is released the microprocessor begins running from a known and predetermined state, fetching its first instruction from memory location 000—the start of the PIPBUG program residing in ROM.

The reset button therefore serves to initialise the system, and is used for this purpose both when power is first applied, and at other occasions whenever one wishes to return to PIPBUG from an applications program (apart from breakpoint returns, which take place automatically).

Below is the PCB pattern, actual size for those wishing to etch their own.

When you have completed wiring the PC board and connected it up to the terminal, reset switch and power supply, carefully remove the 2650 and 2608 chips from their conductive foam and plug them into their respective sockets (with the power turned off).

There is only one adjustment to be made, that in which the 74123 clock oscillator is set up to operate at the correct frequency of 1MHz. This is done with power applied.

If you have access to a frequency counter, it can be done by simply connecting the counter between pin 5 of the 74123 and the grounded negative supply rail, and adjusting the small tab pot until the counter reads 1MHz. This is the preferred way of setting the clock frequency.

However if you don't have access to a counter, the frequency can still be set up fairly accurately using the teleprinter or data terminal itself. This can be done because only when the clock frequency is the correct 1MHz will the software-timed serial output signals produced by the 2650 be at the correct 110-baud data rate required by the terminal.

To adjust the clock frequency using this method, apply power to both the system and the terminal. Then press the reset button, and release. The printer of the Teletype or the screen of the video terminal should print a couple of characters and then become static.

If by some lucky chance you have the correct clock frequency already, the printer or display screen should have displayed a carriage return (CR), a line feed (LF), and an asterisk. This is the programmed output of the PIPBUG program upon initialisation (the asterisk is its prompt signal, signifying readyness for an input command).

Most likely, you won't get this sequence of CR-LF-asterisk straight away. But the idea is to adjust the tab pot slowly and carefully from its maximum resistance extreme, pressing the reset switch after each change until you find the setting where the terminal shows that the characters are being fed to it at the correct rate.

There should be a small zone of the pot's travel in which the characters are printed correctly following the release of the reset button. For most reliable operation, try to set the pot in the middle of this zone.

With this adjustment made, your baby 2650 system is fully operational and ready to begin work (or play!). With the set of ICs, you should have received a Signetics Applications Memo (coded SS50) which explains how to use PIPBUG to feed applications programs into the system, run them, debug them, dump them on paper tape (or cassette), and re-load them. It also gives a listing of PIPBUG itself, which among other things lets you make use of some of its utility subroutines such as the serial input and output routines "CHIN" and "COUT".

```
SIMPLE ANSWER-BACK PROGRAM FOR "BABY" 2650 MICROCOMPUTER
WRITTEN BY J.ROWE, "ELECTRONICS AUSTRALIA" MAGAZINE

ADD.  CODE       MNEMONICS          COMMENTS

440   76 C0      PPSU    40         /SET TTY TO MARK
442   3F 02 86   BSTA,UN  CHIN      /FETCH CHAR VIA PIPBUG RTN
445   C1         STRZ,R1            /SAVE
446   3F 02 B4   BSTA,UN  COUT      /ECHO
449   01         LODZ,R1            /RESTORE IN R0
44A   A4 0D      SUBI,R0  "CR"      /TEST FOR CR
44C   58 74      BRNR,R0  -12       /KEEP GOING IF NOT
44E   04 0A      LODI,R0  "LF"      /IF YES,PROVIDE LF
450   3F 02 B4   BSTA,UN  COUT
453   05 00      LODI,R1            /SET R1=0
455   0D 24 66   LODA,R1  466+      /FETCH ANSWER CHAR
458   C3         STRZ,R3            /SAVE
459   3F 02 B4   BSTA,UN  COUT      /PRINT
45C   A7 0D      SUBI,R3  "CR"      /TEST FOR CR
45E   5B 75      BRNR,R3  -11       /IF NOT,KEEP GOING
460   04 0A      LODI,R0  "LF"      /IF YES, SUPPLY LF
462   3F 02 B4   BSTA,UN  COUT
465   1B 5A      BCTR,UN  -38       /BACK TO START AGAIN

467   47 4F 20                      /ANSWER TEXT
46A   41 57 41
46D   59 2C 49
470   27 4D 20
473   42 55 53
476   59 21 0D                      /ANSWER MUST END WITH A CR.
```

This simple novelty program should help you get your system going. Only the code is actually fed into RAM, starting at location 440 hex.

To help you get your system up and running, a listing is shown for a modified version of the novelty answer-back program which the author originally wrote for the larger PC1001 system. Note that all you actually enter into the system are the two-digit hexadecimal machine code words; the mnemonics and comments are purely to help follow how the program works.

To feed the program into the system, you use the PIPBUG "A" command, typing first "A 440" and then a carriage return. PIPBUG will then type out on the next line "440 XX", where XX is the current content of location 440 (probably random). It then pauses. You then type "76", followed by a line feed, whereupon PIPBUG does a CR-LF, and then prints out the next memory address and its current content. You then type "CO" and LF, and so on until all of the program has been fed in.

Then to run the program, type "G 440" followed by a CR. PIPBUG will then transfer you to the program in RAM.

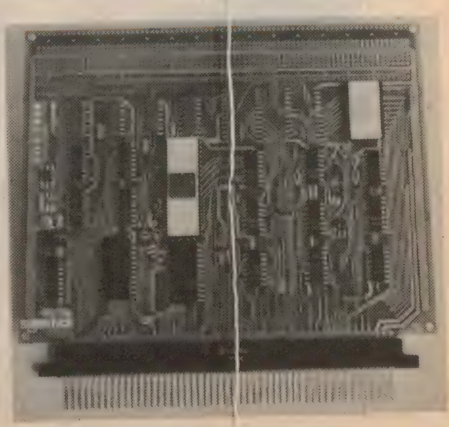
Try typing in a comment, ending it with a carriage return. The program should answer with a terse "GO AWAY, I'M BUSY!"

When you get tired of this reply, it can be changed by feeding in a new string of ASCII characters starting at address 467 hex. Note, however that the message must end with a CRR (hex 0D).

Of course this is just a demonstration program, to get you going. The next step is to write your own, using as a guide the Signetics 2650 programming book supplied with the kit. Happy computing!

For those with a bigger system in mind:

If your ultimate aim is to build up a large 2650 system, it may be better for you to start with the single-board system shown at right, than with our "baby". Available both as an assembled system (code PC1500) and as a do-it-yourself kit (KT9500), it provides all of the features of the baby system together with full memory decoding, fully buffered data and address lines, and two bidirectional 8-bit input/output ports. Further details are available from Philips distributors.



Kit includes calculator + battery charger + NiCd batteries + stand . . . for $11.95

Build your own electronic calculator

We rate this as one of the best value-for-money projects that we have seen in a long time. It is the Model IC-2009 Portable Electronic Calculator from the Heath Company. For just $11.95 you get a set of 6 NiCd batteries; a battery charger; a desk set with its own built-in charger, note pad and Schaeffer pen; and a nifty little four function calculator that's a lot of fun to build!

If we sound enthusiastic about this project from the Heath Company, it's because we are just that. The battery charger and NiCd batteries are well worth the purchase price on their own. You can consider the carefully designed, four function calculator kit with its matching stand as a bonus; and a very attractive bonus at that.

Of course most people will buy the kit for the calculator, and the fun of putting it together. About 8 hours of time are involved in the actual assembly process, most of which involves soldering components to a small PC board—the main logic board. Both the keyboard and the LED display plug directly into the main logic board, leaving only four wire connections to be made; two to the battery and two to the charger plug.

The assembled battery charger unit.

In keeping with the overall standard of presentation, the logic board is double sided with plated through holes, and is made of fibreglass. The keyboard features relatively large keys with a distinct tactile feel, and the display is sloped for easy, wide-angle viewing. A high-impact-strength plastic case gives the completed unit an attractive appearance.

Let's take a look at some of the operating features.

The Model IC-2009 is an 8-digit, four function calculator that performs the usual mathematical functions of addition, subtraction, multiplication and division. For many people, these four basic functions are all that's required. Built into the calculator are a number of useful operating refinements not normally found on "cheap" four function units, including separate 'clear all' and 'clear entry' keys and a constant key.

Operationally, the calculator features a "perfect" overflow system. This means that two numbers, each of which overflows the input register, may be multiplied to produce an answer of the eight most significant digits, with the decimal point displaced eight places to the left of its true position. Overflow of both entry and output is indicated by separate symbols.

Of special interest is the "battery saver" circuit which automatically blanks the display 15 seconds after the last keyboard entry. The last number displayed remains in memory, however, and can be recalled simply by pressing the display recall (D) key. Display recall will also occur upon entry of another number or function.

Other features of the calculator include a floating decimal point, negative number indication, and low battery indication. As well, any fractional number is always preceded by 0 (zero) or a whole number. This latter characteristic limits the input and readout capacity of the calculator to seven digits to the right of the decimal point. The calculator can, however, handle up to 14 places in multiplying and dividing fractional numbers.

The low battery condition is indicated by a special "L" display, indicating that it is time to recharge the batteries. Approximately fifteen minutes of valid calculations are possible after the "L" display has appeared though. Battery charging is accomplished by plugging the calculator into the charger, while continuous operation is possible by keeping the calculator connected to the desk-top charger.

Refer now to the circuit diagram, reproduced here courtesy of the local Heath agents, Warburton Franki Pty Ltd. These circuit details, by the way, are derived from the assembly manual and do not affect the constructor in the ordinary sense.

The circuit employs a five-chip logic set (one MOS calculator chip and four TTL display drivers) from Texas Instruments, an 8-digit LED display from Bowmar, and thirteen transistors. The keyboard is also made by Texas Instruments.

by GREG SWAIN

The 28-pin MOS calculator IC (IC1) is the heart of the circuit. It contains all the "houskeeping" circuitry necessary to perform addition, subtraction, multiplication and division, and can perform these functions either individually or in chain or constant mode. IC1 is also internally programmed to provide protection against key bounce and transient noise signals.

Each time a key is pressed, for example, the IC samples the key switch entry. The same entry is then sampled 2.5ms later to determine its validity. If the entry is valid, the IC either memorises and transfers that particular entry to the display drivers, or performs the desired operation.

Clock signals for IC1 are provided by Q1, Q2 and Q3. Q2 and Q3 form a multivibrator circuit which drives transistor Q1. Thus when Q1 is on, the clock input of IC1 is connected to a positive voltage; when Q1 is off, the clock input is connected through resistor R1 to a negative voltage.

Various points in the circuit require a negative supply voltage, and this is developed by a converter made up of transistors Q4, Q5 and Q6. A signal from Q3 (1/2 the multivibrator) is used to turn transistor Q4 off and on. With Q4 turned on, Q5 is turned on and Q6 is turned off by a signal coupled through C4. Under these conditions a current path is developed through Q5, C5 and D6, which causes capacitor C5 to charge.

When Q3 turns Q4 and Q5 off, Q6 is turned on. The positive end of C5 is then connected to ground through Q6 and forces the other end of C5 to go negative. This reverse biases D6 and forward biases D5, and applies a negative voltage to C6 which acts as a filter. Capacitor C3 is an RF bypass.

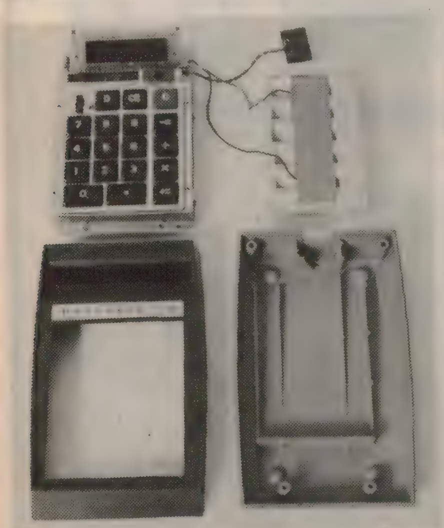
Transistors Q7, Q8 Q9, Q10 and Q11 form the battery saver circuit, whereby the display is turned off some 15 seconds after the last keyboard entry has been made.

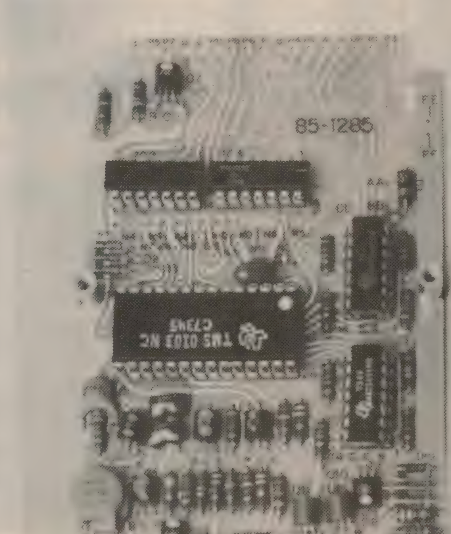
Whenever an entry is made on the keyboard, a voltage is applied through either D2, D3, or D4 and R24 to the base of Q7. Under this condition, Q8 and Q9 are turned off. Current can flow through R34 and R35 and the emitter-base junction of Q11. This turns on Q11, which then connects the segment driver resistors, R15—R23, to the positive supply, and allows the various segments of the LED display to light.

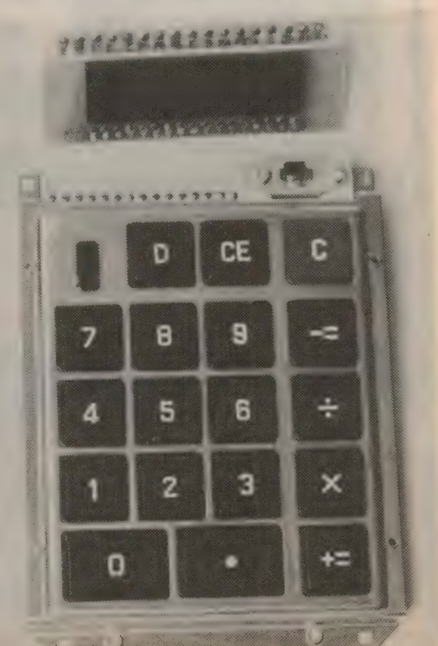
With no entries to the keyboard, Q7 is turned off and C7 begins to charge through R26. When the voltage at the base of Q8 becomes high enough, Q8 and Q9 turn on. The positive voltage from Q9 that is applied to the junction of R33, R34 and R35 turns Q11 off, thus removing the positive voltage from the segment driver resistors R15-R23 and turning off all lighted segments of the display.

The positive voltage from Q9 through R33 turns Q10 on each time D5 of IC1 is pulsed by the internal scan circuits. A positive voltage is now applied to the G segments of the display, while at the same time common cathode P5 is grounded by IC3. This causes the G segment of digit 5 (the centre digit) to light, indicating that the battery saver circuit is in operation.

The display is recalled simply by press-







Above: the almost-completed kit, just before final assembly into its case. View at right shows the assembled main logic board, together with the plug-in keyboard and LED display.

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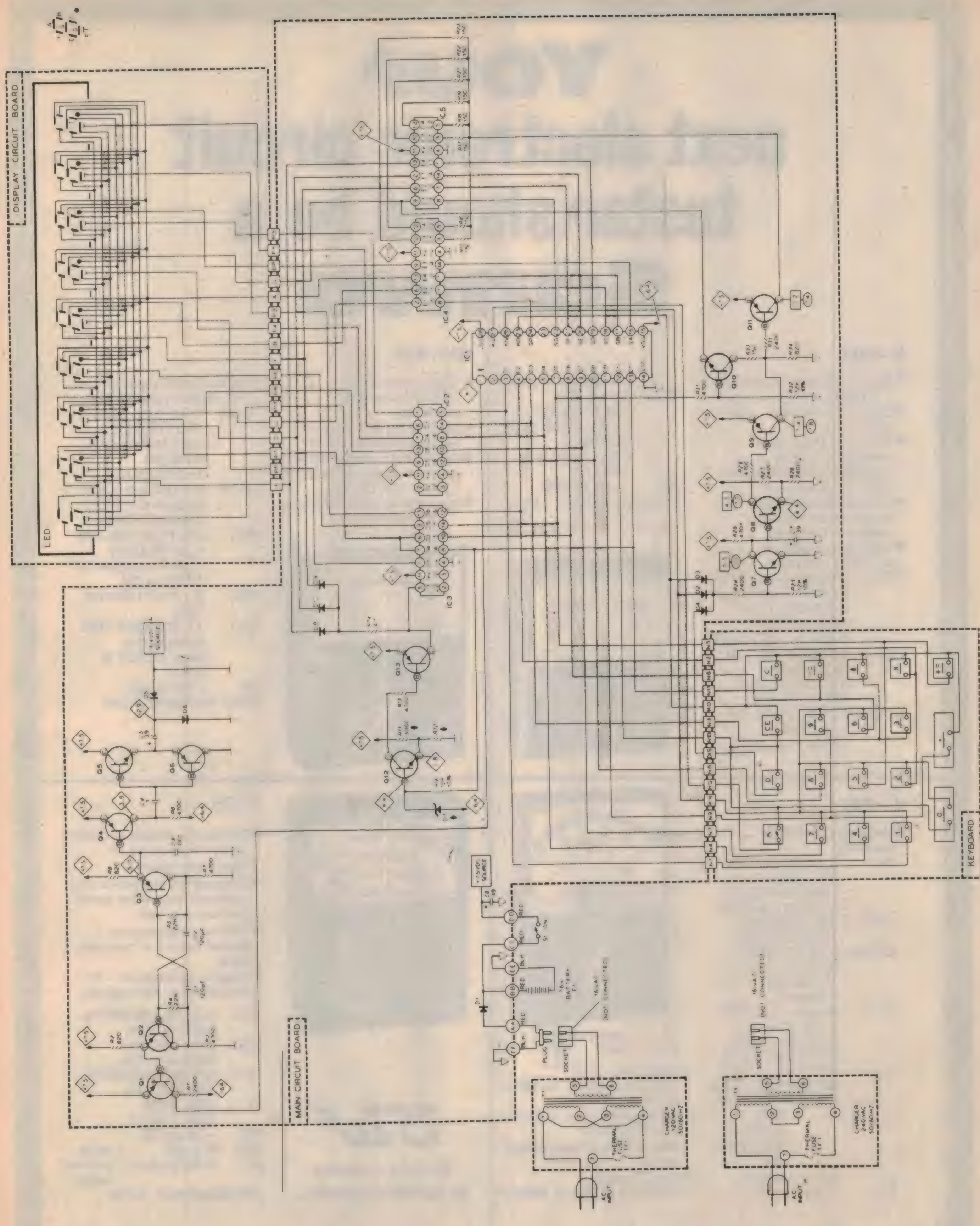

ing the D key, or any number or operation key. This causes Q7 to turn on once again, discharging C7 to ground, and returning the calculator to its "normal mode" of operation. The D key will make the last display reappear, while pressing any other key could result in a different display, depending on the key entry.

The low voltage indicator circuitry is comprised of zener diode D7, transistors Q12 and Q13, diodes D8, D9 and D10. Each time D11 of IC1 is pulsed, zener diode D7 is driven into its zener region. This means that, with one end of D7 being connected to the negative voltage supply, the base voltage of Q12 must change by the same amount that the negative voltage changes.

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Ω x1 x10 x100 x1k x10k x100k (max. 200M) Batt. 1.5Vx1 & 9Vx1
dB –20 to +63
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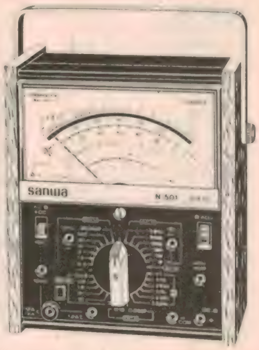

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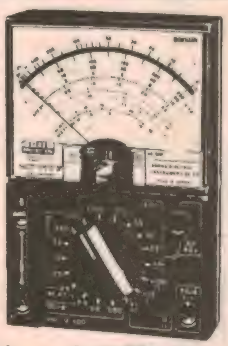
Ω Range – X1 X10 X100 X1k
Midscale –50Ω 500Ω 5kΩ 50kΩ
Maximum – 5kΩ 50kΩ 500kΩ 5MΩ
Batteries 1.5V dry cell (UM-3 or equivalent) X2
LI 0.06mA 0.6mA
LV 3V 3V



LI 6mA 60mA
LV 3V 3V

- **Allowance.** Within ±3% f.s.d. for DCV & DCmA; Within ±4% f.s.d. (±6% for 2.5V) for ACV; Within ±3% of scale length for Ω
- **Size & weight.** 133X92X42 mm & 300 gr

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DCA 0-0.5-10-250m (670mV) ±3%
ACV 0-10-50-250-500-1k (2kΩ/V) ±4%
Ω 0-5k 500k Batt. 1.5Vx1
dB –20 to +36
MΩ 0.1–50) using
μF 0.0002–0.6) external power
120x88x40mm 325gr

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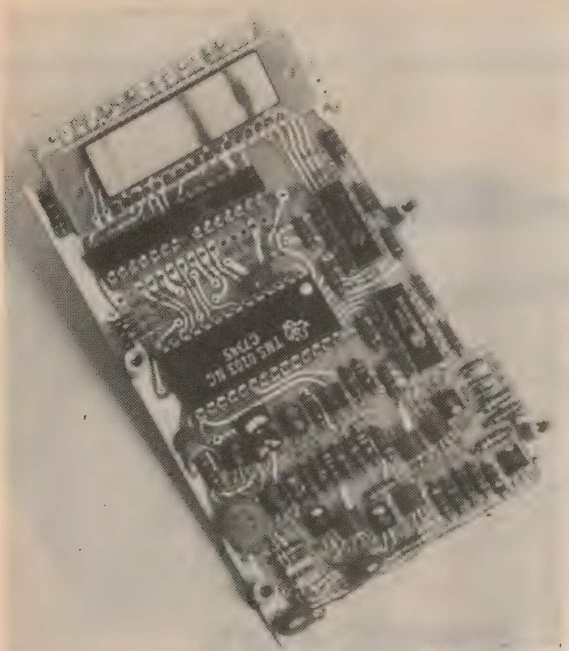

Above: a view of the assembled logic board, with the LED display mounted. Right: the calculator in its stand.

As the negative voltage approaches zero, the cathode of D7 is forced positive. At some point, the base of Q12 becomes forward biased, turning on Q12 and in turn Q13. With Q13 turned on, a positive voltage is applied through D8, D9 and D10 to the E, F and D segments of the LED display. At the same time, P11 of the display is grounded by IC3 to give an "L" readout in the left-most digit of the display.

Battery charging is accomplished by means of a step-down transformer and a single diode D1. When S1 is closed, the battery (E1) is connected to power the calculator, regardless of whether the charger is connected or not.

Diode D1 serves two purposes. First, it prevents the battery from being discharged by the transformer when the charger is connected to the calculator but not plugged into an AC outlet. Secondly, when the charger is connected to the mains it acts as a half-wave rectifier to apply a charging voltage to the battery. Capacitor C8 filters the supply ripple, while fuse TF1 is to protect the transformer from any short circuits on its secondary.

Construction of the calculator is straightforward following Heath's customary step-by-step assembly manual. However, unlike most other Heathkits it would be inadvisable for anyone without previous soldering experience to tackle this project as many of the soldering pads are very close together. The MOS calculator IC can also be damaged by static electricity, and the usual precautions apply when handling this device.

The kit comes in two separate packages, one for the calculator and battery charger and another for the desk set (with its own inbuilt charger). It would appear that in the past the calculator and desk set have been offered as two separate projects, and that the two are now offered together as a "special". What is worth considering is that in 1973 the calculator kit sold for over $90!

We can report that the kit went together with absolutely no problems, and worked right from the word 'go'. In fact, we have yet to encounter a Heathkit that failed to work first try, and that's a record that speaks for itself.

There is quite a lot of work involved in the actual assembly process. It is important to work progressively through the assembly manual, ticking off each step. Be sure to check the polarity of polarised components before soldering; de-soldering components from plated through holes can be quite difficult.

About the only criticism we have concerns the fact that American-style two pin mains plugs are supplied with the battery charger line cords. These should be discarded and Australian-approved 3-pin types substituted.

Included with the kit is a separate "Operation Manual" which gives detailed operating instructions for the calculator. The assembly manual contains the usual detailed troubleshooting procedure, and Heath's 90-day parts warranty and factory back-up service apply.

So what more could you want for $11.95? But if you want a kit, be early. At that low price current stocks won't last long, and any future shipments could well cost a lot more.

The Heath Company is represented in Australia by Warburton Franki Pty Ltd, who have branch offices in all state capitals and in Wellington, NZ. Readers should either write to The Heath Centre, 220 Park St, South Melbourne, Vic 3205, or ring one of the following numbers: Sydney 648 1711, Melbourne 699 4999, Brisbane 52 7255, Adelaide 356 7333, Perth 65 7000, Hobart 23 1841, Wellington (NZ) 69 8272.

An introduction to Digital Electronics—14

Binary Arithmetic

Much of the information handled by digital circuits and systems is in the form of numerical information or numbers—usually binary numbers. Often arithmetic must be performed on the numbers, and to understand the operation of arithmetic circuits you must be familiar with the concepts of binary arithmetic.

by JAMIESON ROWE

As we have seen in earlier chapters, digital circuits and systems are often used to handle numerical information in the form of binary numbers. In circuits which form part of systems such as computers and calculators, it is often necessary to perform arithmetic operations on the information while in this form. In other words, to perform binary arithmetic.

Before we have a look at some of the circuits used to perform binary arithmetic, it may be worthwhile looking at the basic concepts of the arithmetic itself. While in many ways this is similar to the familiar decimal arithmetic, there are differences which can be confusing if not explained.

Let us first look at addition. This is actually rather simpler than decimal addition, as there are only four basic possibilities when two binary digits are added together:

0 + 0 = 0
0 + 1 = 1
1 + 0 = 1
1 + 1 = 0 with 1 to carry

These "four rules of binary addition" replace the usual decimal addition tables, but apart from this the addition of two binary numbers is carried out in a very similar manner to decimal addition.

Digits of the same binary weighting are added together, starting with the least significant digits on the right and working up to the most significant digits on the left—taking any carries into account.

This is best shown by an example. Here is the binary addition of 1101, equivalent to decimal 13, and 110 which is equivalent to decimal 6:

```
 1101 +
  110
 -----
10011
```

You can see that the addition of the least significant bits produces a sum of 1, with none to carry. This also occurs with the next significant bits. However the third pair of bits are both 1's so they produce a sum of 0 with a carry. The carried bit and the most significant bit of the upper number (the "augend") then add in similar fashion to produce a sum of 0, with a further 1 carried. This carry then becomes the most significant digit of the answer, 10011.

If you care to check the answer, you will find it is equivalent to decimal 19—the usual result when 13 and 6 are added together!

Here is a second example of binary addition, using two larger numbers:

```
 110111 +   (augend)
   1001     (addend)
 -------
1000000     (sum)
```

The augend here is equivalent to decimal 55, and the addend to decimal 9. Notice that in this case a carry bit is generated as soon as the two least significant bits are added, and that this carry in effect generates further carries as each further pair of bits is added. Only when the addition reaches the end of the augend does the carry-over cease, to produce a sum of 1000000. This is equivalent to 64, the correct answer.

By the way, the augend is merely the "first" number which we take, while the addend is the number added to it. The augend is not necessarily the larger of the two, as this third example shows:

```
   1110 +   (augend)
1100001     (addend)
-------
1101111     (sum)
```

This example also shows that it is quite possible to have an addition without any carries being generated at all. Here the two numbers are equivalent to decimals 14 and 97, giving a sum equivalent to decimal 111.

How about binary subtraction? Well, the rules for this are also fairly simple. Again there are only four:

0 — 0 = 0
1 — 0 = 1
0 — 1 = 1 but with 1 borrowed
1 — 1 = 0

Using these basic rules as a guide, binary subtraction may be preformed in much the same manner as decimal subtraction. Digits of the same binary weighting are subtracted from each other, starting as before with the least significant bits and working up to the most significant—this time taking borrows into account.

Here is a simple example of binary subtraction performed in this so-called "direct" way, where the first number is the "diminuend" and the "subtrahend" is the number subtracted from it:

```
10110 —   (diminuend)
  101     (subtrahend)
-----
10001     (remainder)
```

Here when the two least significant bits are subtracted, there is a remainder of 1 but 1 has to be borrowed. This gives a borrow bit to be subtracted from the next bit of the diminuend, giving a remainder of 0 with no borrow. Then both of the third bits are 1, so there is again a remainder of 0 with no borrow. Finally there are no fourth and fifth bits in the subtrahend, so these bits of the diminuend are effectively transferred into the remainder.

The remainder is in this case equivalent to decimal 17, which is the correct answer as the diminuend is equivalent to decimal 22 and the subtrahend to decimal 5.

Although this example is quite straightforward, direct binary subtraction tends to become rather tricky when adjacent zeroes in the diminuend cause cumulative borrowing. This is shown in the following example:

```
10001 —   (diminuend)
  111     (subtrahend)
-----
01010     (remainder)
```

Here the two least significant bits subtract to give a remainder of 0, with no borrowing. But the next bit of the diminuend is 0, so a borrow must be made to allow subtraction of the second subtrahend bit. The remainder of the second bit-pair subtraction is thus 1.

When we come to consider the third bit-pair, it starts getting tricky. We already have a borrow from the second pair subtraction, but the third diminuend bit is already 0. So we must again borrow, effectively giving binary "10" (equivalent to decimal 2) in the diminuend bit position. From this we must subtract both the borrow 1 and the subtrahend 1, leaving a remainder of 0.

There is no subtrahend bit in the fourth position, but we have a borrow from the third pair subtraction. However the diminuend bit is again 0, so we must borrow yet again. This effectively gives us "10" again in the diminuend, from which the previous borrow 1 must be subtracted to give a remainder of 1. Finally the borrow from this fourth subtraction must be subtracted from the most significant diminuend bit, to give a 0 in the remainder. Whew!

Incidentally the decimal equivalents of the diminuend and the subtrahend in this

example are 17 and 7 respectively, while the remainder is equivalent to the correct answer of decimal 10.

But the real problem with the direct method of binary subtraction from a practical point of view is that it cannot cope easily with situations where the subtrahend may be larger in magnitude than the diminuend, giving a negative remainder.

To illustrate this, consider the following example where the diminuend is equivalent to decimal 7, and the subtrahend to decimal 9:

```
       0111 — (diminuend)
       1001   (subtrahend)
   (—1)110    (remainder)
```

The subtraction of the least significant bit pair is straightforward enough, with a remainder of 0 and no borrowing required. The next bit pair are also straightforward, this time with a remainder of 1 and no borrowing. And the third bit pair are the same. But what happens with the fourth or most significant bits?

Here we are in trouble, because in order to produce a normal positive remainder, we would need to borrow. But there is nothing left to borrow from!

In effect, then, we are left with a remainder of —1 in the most significant bit position, as shown. And in this case the bit position concerned has a binary weighting of 8, so that we have a two-part remainder: the positive part, corresponding to decimal 6, and the negative part corresponding to —8. To get the correct answer, equivalent to decimal —2, we would have to add these two parts of the remainder together algebraically.

Note that the need to do this extra step didn't actually become apparent until we got to the last pair of bits in the subtraction. Until then, it seemed completely normal and straightforward.

This is what causes problems when it comes to performing the direct method of binary subtraction with digital arithmetic circuits. If a subtractor circuit is to be able to cope with situations where the subtrahend may be larger in magnitude than the diminuend, it must not only be provided with the facility to perform algebraic addition of partial remainders, but also with the logic to detect when this is to be done. To do these tasks efficiently requires quite complex circuitry.

As it happens, there is a very much simpler and more convenient way around the problem. Instead of performing direct subtraction, the same result is achieved by performing an equivalent operation: complementary addition.

Complementary addition relies on the fact that subtracting a number B from another number A is basically the same as adding minus-B to it:

$$A - B = A + (-B)$$

In other words we can perform subtraction by straightforward binary addition, merely by converting the subtrahend number beforehand into its negation or complement.

The most common type of complementary addition uses the so-called "two's complement" of the subtrahend number.

The two's complement of a binary number is defined as the difference between the number and the base 2 raised to the same power as the total number of bits being used, i.e.,

$$C = 2^b - N$$

where N is the number concerned, C is its two's complement, and b is the number of bits being used to represent them.

This may seem a bit mysterious, but an example should make it more clear. In many digital systems, 8-bit words are used to represent numbers, so in such systems the two's complement of a number is defined as the difference between the number and two raised to the power of 8, or the equivalent of 256 decimal (100000000). Hence in an 8-bit system, the two's complement of a number N is given by:

$$C = 100000000 - N$$

where both C and N are in binary notation. Note that as the eighth power of two is actually a 9-bit number, it is effectively the same as zero in the eight-bit system concerned (the ninth bit would be ignored). So that this expression can in fact be rewritten as

$$C + N = 00000000$$

or in other words, the two's complement of a number is that number which when added to the number produces a sum of zero.

Even this is not all that convenient from a practical point of view, as you'll find if you try to work out a few specific examples. However as it happens there is a quite easy way of finding the two's complement of a binary number: complement each bit individually, and then add 1 to the resulting number.

Here are a couple of examples to illustrate this. First, the 8-bit two's complement of the binary equivalent to decimal 5:

```
    Original number: 00000101
Complement each bit: 11111010
         Then add 1: 11111011
```

And the 8-bit two's complement to the equivalent to decimal 73:

```
    Original number: 01001001
Complement each bit: 10110110
         Then add 1: 10110111
```

As you can see it is fairly easy to find the two's complement of a number using this method.

To help you visualise two's complement notation a little more clearly, table 1 shows the 8-bit binary equivalents to the decimal numbers from 1 to 16, together with those for their two's complements. The equivalent to 0 is also shown, for reference.

If you care to work it out, you will find that the two's complement notation for —1 is basically the same as that for 255 in normal or unsigned binary notation. Similarly that for —2 is the same as 254, that for —3 the same as for 253, and so on. So that the negative numbers are effectively "working down" from 256, as they should where 8-bit two's complement numbers are concerned.

Fairly obviously, the negative numbers can't "work down" indefinitely, because they would become indistinguishable from the positive numbers. In fact to allow the two to be distinguished unambiguously, an arbitrary convention is adopted, to divide the total number of available bit combinations into two roughly equal groups—one for the positive numbers, and the other for negative numbers.

The convention adopted is that numbers having a 0 in the most significant bit position are interpreted as being positive, while those with a 1 in the most significant bit position are interpreted as negative.

So that with 8-bit numbers, the 256 available bit combinations are divided into 127 positive numbers, zero, and 128 negative numbers. The positive numbers range from 1 to the equivalent of decimal 127, or in binary from 00000001 to 01111111; while the negative numbers range from —1 to the equivalent of decimal —128, or in binary from 11111111 to 10000000.

Using two's complement notation, subtraction is performed in exactly the same manner as addition. The only difference is that the subtrahend is converted into its two's complement before the addition is carried out.

If we wish to subtract the equivalent of decimal 7 from the equivalent of decimal 25, for example, this is done in the follow-

TABLE 1

Decimal	Binary (2's Complement)
16	00010000
15	00001111
14	00001110
13	00001101
12	00001100
11	00001011
10	00001010
9	00001001
8	00001000
7	00000111
6	00000110
5	00000101
4	00000100
3	00000011
2	00000010
1	00000001
0	00000000
—1	11111111
—2	11111110
—3	11111101
—4	11111100
—5	11111011
—6	11111010
—7	11111001
—8	11111000
—9	11110111
—10	11110110
—11	11110101
—12	11110100
—13	11110011
—14	11110010
—15	11110001
—16	11110000

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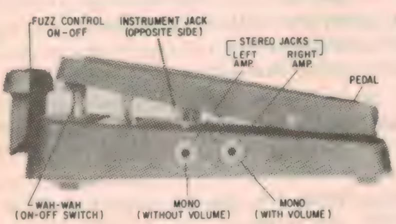

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ing way. First, the binary equivalent of 7 is converted into its two's complement:

Original: 00000111
Bits Complemented: 11111000
1 added: 11111001

The two's complement is then simply added to the equivalent of 25, with any carry-over from the eighth bit addition ignored since we are working with 8-bit numbers:

Augend (25): 00011001
Addend (—7): 11111001
Sum (18): 00010010

With two's complement arithmetic, there is no problem in coping with subtractions where the subtrahend may be larger than the diminuend, giving a negative result. All that happens is that the answer has a 1 in its most significant bit position, signifying that it is negative.

This is shown by the following example, where the equivalent of decimal 7 is added to the two's complement equivalent of —43. In effect, this is the same as subtracting 43 from 7:

Augend (7): 00000111
Addend (—43): 11010101
Sum (—36): 11011100

From a practical point of view, the advantage of using two's complement notation is that both addition and subtraction may be performed by a relatively straightforward binary adder circuit. Most binary arithmetic circuits are thus designed to handle numbers in two's complement notation, and are described as performing "two's complement arithmetic".

So far, we have considered only addition and subtraction of binary numbers. In fact these are the arithmetic operations most often performed, as multiplication and division are often performed by repetitive addition or subtraction methods.

Binary multiplication is at times performed by the "traditional" approach, particularly when numbers must be multiplied as rapidly as possible. So we should perhaps look briefly at the basic concept.

As with addition and subtraction, there are again only four basic "laws" where multiplication is concerned:

$$0 \times 0 = 0$$
$$0 \times 1 = 0$$
$$1 \times 0 = 0$$
$$1 \times 1 = 1$$

Using these as a guide, the actual multiplication of two binary numbers may be performed in a similar manner to decimal multiplication. The multiplicand is multiplied separately by each bit of the multiplier, giving a series of partial products which are then added together to give the final product.

This should be clear from the following example, which shows the equivalent of decimal 22 multiplied by the equivalent of decimal 5:

```
   00010110×  (multiplicand)
   00000101   (multiplier)
   --------
   00010110
  00000000    (partial products)
 00010110
 --------
   01101110   (final product)
```

Note that only the first three partial products are shown, as the remainder are all zero in this example. Note also that only the eight least significant bits of the final product are shown, as these would the only bits used in an 8-bit system.

More importantly, though, note that the partial products are obtained much more simply than in the case of decimal multiplication. Where the multiplier bit concerned is a 0, the partial product is also zero; where it is a 1, the partial product is simply the multiplicand displaced to the left by the appropriate number of bit positions.

This illustrates an important point about binary numbers: shifting a number one place to the left is equivalent to multiplying by 2, while shifting one place to the right is equivalent to dividing by 2. This corresponds exactly to decimal notation, where a shift to the left is equivalent to multiplying by 10, and a shift to the right to dividing by 10.

High-speed binary multiplier circuits tend to use this as a way of performing multiplication by the traditional method we have just illustrated. The partial products are obtained by repetitive shifting of the multiplicand to the left, and each time using the appropriate bit of the multiplier number to determine whether the partial product is added to the accumulating final product.

As mentioned, binary multiplication is very often done not by this traditional method, but by repetitive addition. This simply relies on the fact that multiplication of one number by another is equivalent to adding the multiplicand to itself a number of times, equal in number to the multiplier.

Hence an alternative approach to multiplication is to arrange that the multiplicand number is added to itself in a normal binary addition circuit, and each time an addition is performed the multiplier number is decreased by 1 (decremented). The process is arranged to stop when the multiplier reaches zero, whereupon the multiplicand must have been added to itself the correct number of times.

This is the method of multiplication used by most minicomputers, microprocessors and digital calculators, as we shall see in a later chapter.

Binary division is generally performed in a similar fashion, except that repetitive subtraction is used instead of addition. As before the subtraction is generally done using two's complement addition.

Before we leave the topic of binary arithmetic for the time being, there are a few points which should perhaps be made.

As we have seen, it is very convenient to use two's complement notation in performing binary arithmetic. This involves using one bit of the word length available—the most significant bit—to indicate the sign of each number.

One result of this is that a given word length can only be used to represent half as many absolute magnitudes as with unsigned binary notation. For example with unsigned notation, 8-bit words can represent the numbers from 0 to the equivalent of decimal 255, whereas with two's complement signed notation they can only represent absolute magnitudes from 0 to 127 in the positive direction, and from 0 to 128 in the negative direction.

Of course there is the added advantage of being able to represent negative numbers as well as positive, so that the information-carrying efficiency is not impaired. But despite this, there are applications where the halving in the absolute magnitude range is significant.

One way of getting around this is to use longer words to represent the numbers. Hence if 16-bit words are used instead of 8-bit words, with two's complement notation the range of numbers which can be represented increases significantly: from the equivalent of —32,768 decimal, to the equivalent of 32,767. With 24-bit words the range expands much further again, equivalent to the decimal range from —8,388, 608 to 8,388,607.

Some large digital systems use 16-bit, 24-bit or even 36-bit words throughout, in order to have the necessary magnitude range and arithmetic resolution. However this tends to be quite costly, as the complete system must be capable of handling the longer words.

With smaller systems, an alternative approach is usually adopted. Here the system is designed to handle relatively small words—say 8 bits in length—but when required the arithmetic circuitry can effectively handle larger numbers by dealing with them in "multiple word chunks".

This is known as the technique of multiple precision. Most commonly, either double precision or triple precision are used, which as the names suggest involve using either two or three separate words to represent each number.

Hence if an 8-bit system is said to be capable of performing double-precision arithmetic, this simply means that its arithmetic circuits are effectively able to perform arithmetic on 16-bit numbers, handling them in two separate steps: first the 8 least significant bits, and then the 8 most significant bits.

Similarly an 8-bit system capable of performing triple-precision arithmetic has arithmetic circuits effectively capable of performing arithmetic on 24-bit numbers, handling them in three separate steps.

As you might imagine, the advantage of multiple precision techniques is that most of the digital system concerned is only required to handle relatively small words. Even the multiple-precision arithmetic circuits themselves may be somewhat simpler than circuits designed to handle the larger words, if the arithmetic is actually performed in separate steps. All that may be required is a flipflop or two to store carry-over from one group of bits to the next, and perhaps a partial product storage register in the case of a multiplier.

Esoteric amplifier design eliminates T.I.D.

Auditec K07 80W RMS per channel stereo amplifier

The Auditec K07 is a no-holds barred amplifier design in which particular effort has been made to eliminate transient intermodulation distortion. It has a total transistor complement of 88 transistors, and a power rating of 80 watts per channel into 8 ohm loads with both channels driven.

REVIEWED BY LEO SIMPSON

Designer C. T. Murray of The School of Electrical Engineering at Sydney University is an acknowledged authority on amplifier design in Australia. The design concepts involved here provided the basis for a paper presented by him in Proc IREE. Auditec Australia Pty Ltd have combined the power amplifier with a preamplifier also designed by C. T. Murray and, in collaboration with him, developed a complete high performance unit stereo amplifier.

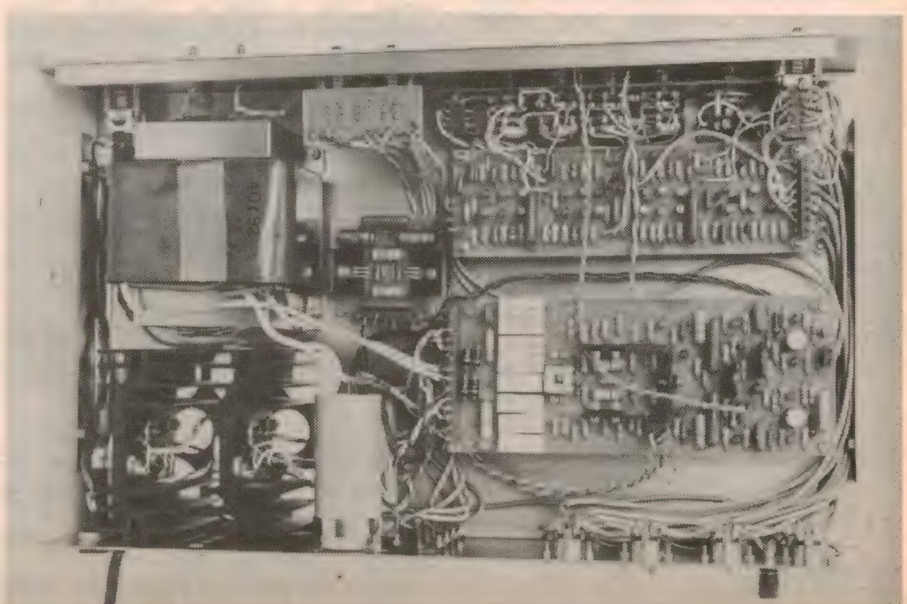
Great emphasis was laid on minimising transient intermodulation distortion. This type of distortion can occur in any feedback amplifier where the open loop bandwidth is significantly smaller than the closed loop bandwidth. What happens is that high amplitude, fast rise time signals tend to be clipped in the early stages of the amplifier before the feedback can respond and reduce the gain of the system. The effect can be equivalent to short bursts of 100% intermodulation distortion.

In fact, transient intermodulation distortion is now recognised by designers around the world as a parameter of paramount importance. Paradoxically however, there is no recognised or defined procedure for measuring and quantifying the effect. But it is doubtless a potential cause of listening fatigue, and of harshness in the sound quality of some amplifier designs.

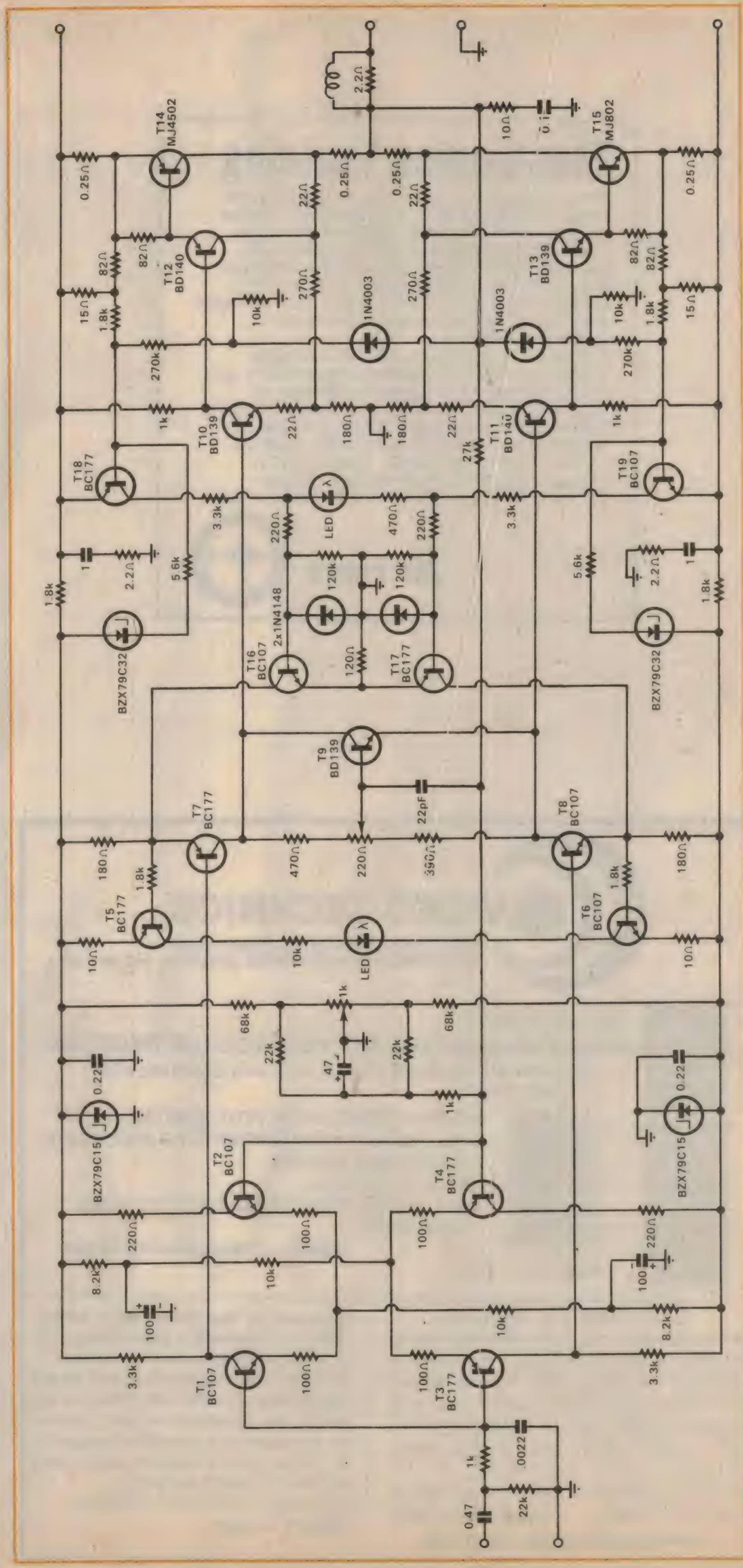
The recognised approach to minimising TID is to ensure that the amplifier has as high a performance as possible before feedback is applied. At the very least, open loop bandwidth should be as wide as the signal to be handled. Moreover, the degree of feedback should be minimised, consistent with providing a low steady-state harmonic distortion figure.

C. T. Murray's design represents an all-out effort to achieve this aim. The amplifier is a fully-complementary configuration which is claimed to give excellent linearity before negative feedback is applied. The configuration is not unique, however, being used in a number of commercial high power amplifiers.

Of special interest is the peak clipping indicator and overload protection circuitry. Transistors T5 and T6 monitor the current in the driver stages T6 and T7. If these stages clip the signal the stage current is interrupted and T5 or T6 momentarily extinguish the LED. T16, T17, T18 and T19 monitor the output stage current and remove the input signal to T10 and T11 if an overload condition occurs. A red LED is lit to indicate the fault and the



The power amplifier stages employ nineteen transistors in a fully complementary configuration claimed to give excellent linearity before feedback.



amplifier must be turned off to restore normal operation—after the fault condition has been removed, of course.

The preamplifier configuration employs the same principles as the power amplifier. A basic complementary differential amplifier comprising six transistors is used for each basic module in the preamp. This gives a total of twenty-four transistors per channel in the preamplifier.

Auditec market separate modules for the power amplifier and preamplifiers. Or you can buy the whole kit, which was submitted to us for review.

The amplifier kit arrived packed in a substantial composition board case. The heavy C-core transformer is bolted to the chassis for safe transit. Amplifier boards, preamplifier module and heatsink modules are all packed in plastic, as are all the smaller pieces of hardware. The kit was indeed complete down to the last detail.

Assembly of the amplifier is fairly straightforward and substantially eased by the fact that the amplifier and preamplifier modules are fully assembled and with all adjustments optimised and sealed.

There is no instruction manual. Instead a duplicated sheet is provided with the assembly diagram on one side and the wiring diagram on the other. Both diagrams are well set out and show all necessary detail. The assembly diagram even nominates the screw and nut type in each location and includes dimensional diagrams of all types.

But even a brief instruction sheet would have been helpful, and a preferred order of assembly and wiring would have made the job more straightforward. As it was, it took about an hour to do the mechanical assembly and about eight hours to complete the wiring—so don't expect to complete the job in an evening.

We would recommend that all input and output wiring be completed before installing the amplifier modules.

We made a small modification to the wiring in adding PC pins to the loudspeaker switching PCB. This made it easier to anchor the wires when soldering. We were also tempted to simplify the rectifier wiring but we did not, to avoid prejudice to the test results. As it is, the separate bridge rectifier on each power module is paralleled with its duplicate, which seems a little pointless.

When wiring is completed, the end result is reasonably neat and tidy although, if we had taken the trouble to do cable lacing it would doubtless be neater. This would be a matter for the

individual. But we were thankful not to have to perform any adjustments or trouble-shooting—those stacked PC boards would make access a problem.

A good feature of the design is the hefty twin C-core transformer. In our opinion this is almost mandatory on any amplifier that purports to be a high performance unit. It is quiet and does not have high flux leakage, so the amplifier can be positioned close to turntables or cassette decks without hum problems.

Having duly completed the amplifier and given it a quick check we then assessed it in the normal fashion.

Presumably an enthusiast who built the amplifier would be more interested in its performance than in its operating convenience, but we feel that it does fall short of many commerical amplifiers in terms of human engineering. The control knobs are too small, and too close together. This gives them a heavy feel, compared to the controls on most imported quality amplifiers.

We liked the "Softness" control which drops the overall gain, while boosting the bass and treble slightly. While you may not find the term used elsewhere, it does make more sense than the usual "Loudness" control.

We felt that the LED indicators protrude too far, possibly rendering them prone to damage. And the green "peak clipping" indicators are rather anaemic looking. Why can't they be red?

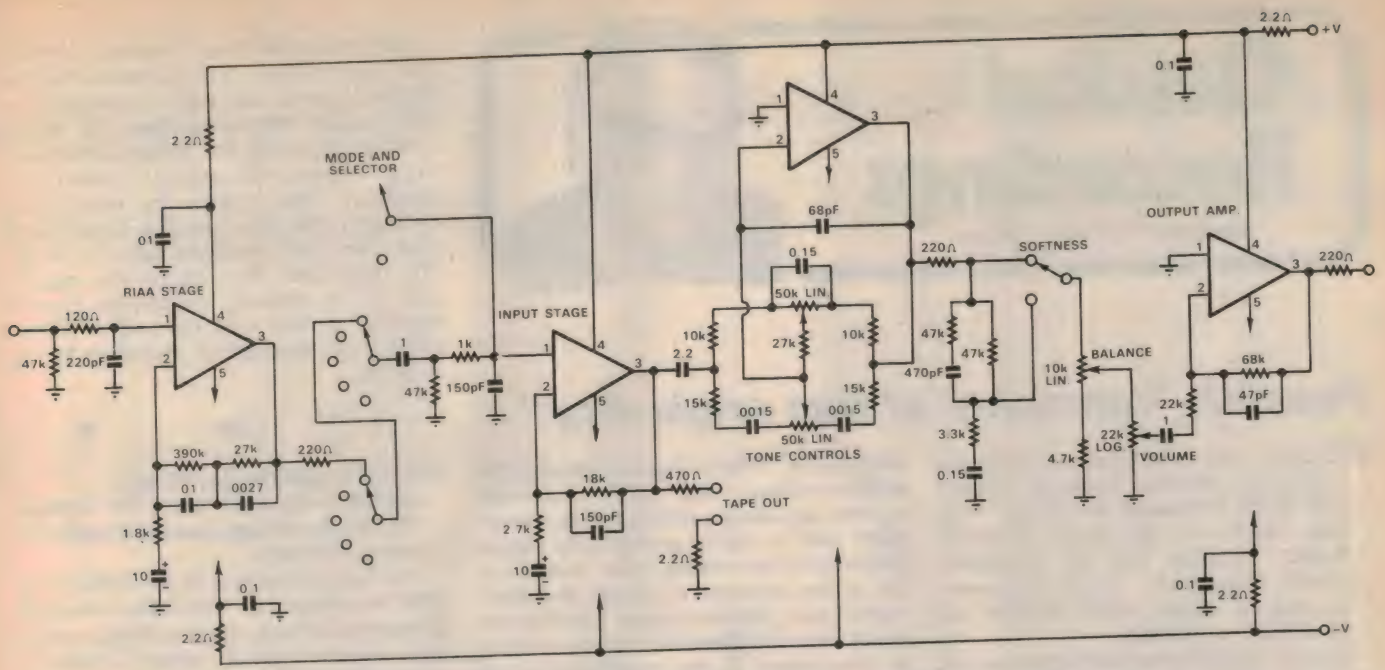
We also thought the loudspeaker switching unusual. Why switch the headphones? It would seem better to have the headphones permanently available and revamp the switch to allow simultaneous operation of two pairs of loudspeakers.

On the other hand, there is a choice of phono or DIN sockets in parallel for the input connections—a convenience not found on competitive amplifiers. Loudspeaker connections are via polarised 2-pin DIN sockets.

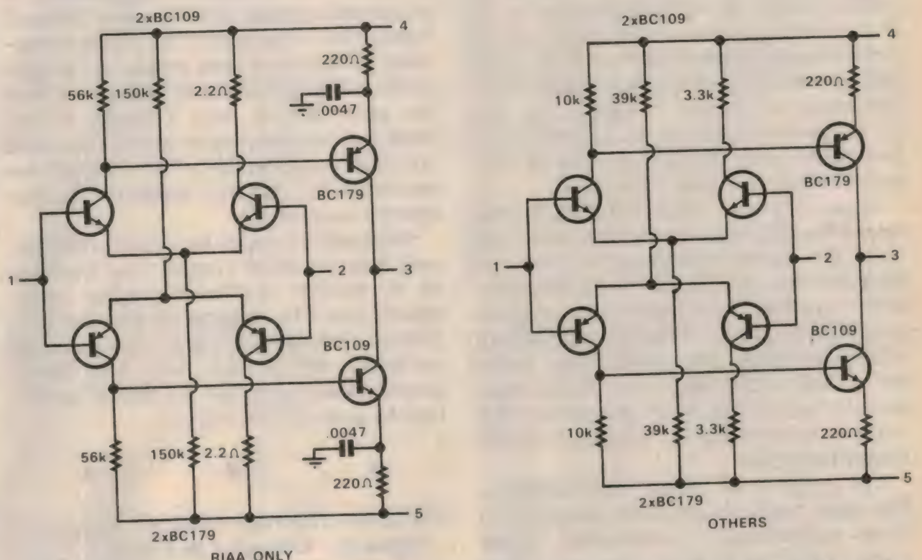
While the control facilities are adequate for all normal applications, we feel that the amplifier should have a loudspeaker protection facility, which could also be used to mute the amplifier at turn-on. As it is, it is possible to produce quite a loud turn-on thump if the volume control is fairly well advanced.

We also found the peak clipping indicators rather ineffective. Even when the amplifier is driven hard into clipping the LEDs only dim slightly. By that time the effect is well and truly audible. In our opinion the circuit could be redesigned to advantage, so that the LEDs flash when an overload occurs.

To be sure, these are small points, which do not curtail the capabilities of



The preamplifier and tone control circuitry. Each channel employs four basic differential amplifier modules.



Above are the circuit configurations for the basic differential amplifier modules. The circuit at left is used for the RIAA preamplifier stages only, while the circuit at right is used for the three remaining stages.

the amplifier in its prime task. But, in a prestige design, it would be nice to find pleasure in the detail as well as the concept!

Subjective performance of this amplifier is likely to be a matter for long and earnest discussion and appraisal amongst keen enthusiasts, if only because of the claims made by the designer and Auditec, and their seeming pre-occupation with transient intermodulation distortion. We don't plan to buy into the argument just here, beyond commenting that the amplifier can certainly stand up to comparison with better known and exotic competitive designs. But we certainly can quote our objective measurements.

Rated power of the Auditec K07 is 80 watts per channel into 8 ohm loads and 100 watts per channel into 4 ohm loads, both channels driven. Our measurements yielded 66 watts per channel into 8 ohm loads and 82 watts per channel into 4 ohm loads. With one channel driven, the figures were 75 watts into 8 ohms and 95 watts into 4 ohms. For 16 ohm loads, we measured 41 watts per channel.

Total harmonic distortion was below the limits of our measuring equipment for most of the time, and it would appear to be well below 0.1% at all times.

Frequency response with tone controls set for best response is within 1dB from 30Hz to 20kHz. RIAA equalisation is within 0.5dB from 30Hz to 15kHz.

Signal to noise ratios for the high level inputs are 84dB with respect to 70 watts with open circuit inputs.

We thought that the input overload capability on high level inputs was a little modest at 1.5V RMS. Use of the tone controls could worsen this. Phono sensitivity was 4mV for full power and overload capability was 80 millivolts at 1kHz. This is adequate. Phono signal-to-noise ratio was 73dB with respect to a 10mV input at 1kHz and full power.

Tone control range has been deliberately restricted in accordance with the philosophy of the designer. Boost and cut is +7 and −9dB at 50Hz and +9 and −10dB at 15kHz. Subjectively, therefore, the tone controls seem to have only a marginal effect. While it is arguable that tone controls will be unnecessary when premium quality loudspeakers are used, it leaves little room for program correction—hence an area for discussion.

Separation between channels is very high at about −70dB over the audio range with the undriven channel input short circuited. This is an important parameter, and with this figure the amplifier should be better in terms of separation than any likely source.

Stability is excellent. Large values of capacitance shunting the load have virtually no effect on the performance.

In conclusion, we can state that this is a fine amplifier. But we are unable to either agree or disagreee with Auditec's claim that it "will sound superior" to "most of the highest quality units available". A lot of controlled A-B testing would be necessary to establish that claim.

If you wish to find out more for yourself, contact Auditec Australia Pty Ltd, at 10 Waitara Avenue, Waitara, NSW 2077. Price of the complete kit for the Auditec K07 is $390.00.

Classical Recordings

Reviewed by Julian Russell

Puccini: "moments of true originality"

PUCCINI — Messa di Gloria. Kari Lovaas (soprano); Werner Hollweg (tenor) and Barry McDaniel (baritone) with the Chorus of the West German Radio, Cologne, and the Frankfurt Radio Symphony Orchestra conducted by Eliahu Inbal. Philips De Luxe Stereo 9500 009.

It is not surprising to find influences of previous composers in the early works of those who succeed them. Puccini was no exception especially in this Mass, the bulk of which he wrote at the age of 20. It is surprising to learn from the sleeve notes that although in later years he came to be—and still is—the most popular contemporary composer of operas, he was by no means a stranger to church music. Indeed he was the descendant of four generations of church musicians.

Again it is not surprising that, having heard Verdi's Aida for the first time and also the same composer's glorious Requiem just before he wrote the Mass under review, that memories of them would long remain in his mind. There are other influences, too, in the Mass and a few straight out plagiarisms. All his creative life Puccini was never averse to doing a little borrowing of material which suited his needs.

Yet despite all these considerations this early Mass is eminently tuneful and quite astonishingly professional, made very clear indeed by the splendid engineering and the performance by the Israeli conductor Eliahu Inbal. Like Verdi's Requiem—and much Italian church music during the 19th century—the Mass tends to be operatic though none the less reverent for that reason.

After a delightfully lyrical Kyrie the Gloria opens with a disappointingly banal march though later this does open out into more liturgical sound. The Gloria is the longest movement in the Mass consisting of no fewer than nine sections, one of which is a glorious tenor solo which foreshadows later tenor arias. Werner Hollweg sings it as if he's enjoying every note. Despite some occasional technical lapses this Gloria proclaims indisputable genius in the making.

Barry McDaniel (baritone) doesn't always seem comfortable in his lower register and Kari Lovaas is an authoritative rather than an alluring soprano, sometimes producing a rather wider than permissible vibrato. Puccini handles his masses—choral and orchestral—with superb assurance, finishing the movement with a highly professional fugue followed by an exciting coda. To sum up, it is a fine movement despite the influences I have stressed above which might worry some listeners but which caused no discomfort to my enjoyment of its splendid workmanship and moments of true originality.

The Credo is magnificently dramatic in an operatic sense. Unfortunately the final Agnus Dei is the least interesting movement in the work and makes an anticlimatic ending to so much fine music that has gone before. And if during it you think you are listening to Manon Lescaut, you won't be mistaken. Puccini used the section later for the madrigal in that opera's second act.

Although this early Mass will undoubtedly interest most Puccini fans because of its novelty it should please many others too. The singing of the Cologne Chorus and the playing of the Frankfurt orchestra are of the very first order, which should provide an added attraction to prospective buyers.

* * *

CHOPIN—The Four Scherzos. Berceuse, Opus 57. Nocturne in E major, Opus 62, No. 2. Rafael Orozco (piano). Philips De Luxe Stereo 6500 978.

Orozco plays Chopin with admirable articulation and a beguiling couch, but his readings are never effinate. In all the items on this disc he uses just the right amount of rubato and carefully calculated contrasts in sonorities. There is no pedal smearing. Orozco wisely adds no "novelties" to his interpretations unlike Roger Woodward whose latest recording is discussed below.

Orozco is completely orthodox, which in no way detracts from the beauty of his performance. The sometimes mercurial changes of mood in the Scherzos are always unfalteringly established without interference to the composer's general argument. Now and again the fleetness of some passages might well threaten disaster to a less well equipped performer, but this never happens and no note ever treads on the heels of its predecessor.

After the often fiery Scherzos—I know the Italian plural is Scherzi but writing in English I prefer the English translation—the E Major Nocturne, Opus 62, No. 2 is truly nocturnal, the melody enchantingly shaped, the mood consistently elegiacal. Then comes the bewitching delicacy of the Berceuse that should rock even the most obstinate baby to sleep. The right-hand decorations and expansion of the melody are always cream-smooth. If ever you fell ruffled about anything try playing this instead of taking a valium.

* * *

DEBUSSY—Quartet for Strings. BARTOK—Quartet No. 5 for Strings. The Sydney String Quartet. Cherry Pie Stereo CPF1028.

The first movement of the Debussy is a bit heavy-handed. The tone is too full, sometimes closely approaching coarseness for this type of music. However, technically the playing is as proficient as that of most visiting groups of the same combination.

The players' complete unanimity is a matter for considerable admiration. Try the second movement to check this feature. After the first movement the rest of the work is much more Debussy-like—perhaps because I turned the gain down a bit. The musicians play the work as written without any tiresome striving after an "original" reading. Thus the smooth progress of the second movement, delivered with sensitive inflections but without any gusty emotionalism, is eminently pleasing.

An additional feature of interest is that the quartet uses 18th century instruments of fine quality loaned to them by the Australia Council.

The players change their style convincingly in the Bartok. They attack the first movement with fire and great precision and don't fall into the trap of unduly prolonging this intensity. The nocturnal slow movement is faultless in mood and execution.

When one considers that Bartok wrote the best body of string quartets since Beethoven, not nearly enough of it is at present available in contemporary catalogs, which makes this new one all the more welcome. It can take an honourable place among the very best if one perhaps excepts the Hungarian Quartet's great version for DGG, long ago deleted and well worth another reissue. The World Record Club did reissue it some years ago but I cannot trace any later pressings.

In comparison, the recording under review misses a little of the rhythmic piquancy added by the Hungarians in the "Bulgarian" scherzo. The fifth movement is very good but I think that after another couple of years examination of the score will reveal even more of its riches. On the whole it is an excellent example of Australian playing and recording at its best.

BERLIOZ—Harold in Italy. Prelude to Act 3 of The Trojans at Carthage. Nobuko Imai (solo viola) with the London Symphony Orchestra conducted by Colin Davis. Philips Dolby Stereo Cassette 7300 441.

At her first entrance Nobuko Imai immediately impresses by her noble tone sensitively controlled. Moreover, she has a true viola tone which disassociates itself from the too often heard viola tone that sounds more like a violinist playing on the G string. It is immediately obvious that here is a true viola virtuoso and moreover one in complete sympathy with Davis' deep understanding of Berlioz music.

Of course, in a collaboration as perfect as this the reverse may be true—that it is Davis accommodating his conducting to the soloist's needs. Davis' reading has enormous nervous energy and so has Imai's. When listening to this work, inspired by Byron's Childe Harold, it is essential to remember that it is NOT a concerto for viola and orchestra but an unusual symphony with a very important solo viola part.

The viola, of course, represents Byron's hero, though it tends to express his personal reaction to his surroundings rather than the Byronic idea of using him to delineate novel landscapes and happenings. However, the important thing about this first class performance is that both conductor and soloist share the same ideas about the interpretation.

The Dolbyised sound is very good with a wide dynamic range and very satisfactory clarity. Listen to the woodwind chords at the end of the Pilgrims' March that concludes a movement taken at a beautifully relaxed tempo that never lags. This tempo increases, to my mind perfectly correctly, as the procession moves into the daylight, an effective contrast to the atmosphere of the dawn and dusk sections. The change is as gradual as the changing intensity of the light and ends in a twilight mood.

In terms of the fidelity of the engineering, listen also to the final viola arpeggios played sul ponti cello—on the bridge of the instrument. My only criticism of the performance—which I enjoyed so much that I feel churlish to mention it—is that Imai's reading tends to be a shade too explicit in identifying with Harold rather than the surrounding scenery.

Of all the recordings of this work that I have heard Menuhin gets closer to the Byronic idea than any other present day soloist, at any rate on disc. But to return to the cassette under review, the London Symphony Orchestra is at the top of its form. And as a generous fill there is a grand performance of the Prelude to the third act of The Trojans at Carthage.

Berlioz' marvellous orchestration reminds me of a remark the great pianist Artur Schnabel made to me many years ago and which I have never forgotten. "Wagner must have been a little worried," he said with a mischievous smile, "when he looked at his own score of Tannhauser and saw how black it was, and then at Berlioz' and saw how white the pages looked despite the Frenchman's wonderful orchestral effects".

Another feature to note in the Prelude is Davis' appreciation of the characteristically long French legatos in many of the string passages—and some of the brass, too. A highly recommended cassette.

* * *

BEETHOVEN—Piano Sonatas Nos. 20 in G, 14 in C Sharp Minor, and 3 in C Major. Roger Woodward (piano). RCA Stereo LRLI 5097.

Some two years ago when Roger Woodward visited Sydney for the foundation of the Annual Music Rostrum series—he had much to do with its original organisation—I failed to respond to all his playing with the same ardour as some of my colleagues. I could find no point of agreement with a performance of Chopin Scherzo that made it sound rather like the first movement of Beethoven's Hammerklavier Sonata.

True Woodward played many other works by various composers angelically but the Scherzo still remains in my mind as an act of wilful perversity. Woodward spends much of his time in Warsaw and one fellow-critic—who, by the way is rightly proud of some Polish blood—argued that Woodward's was the "new" way of playing Chopin in Poland today. She claimed that this style is based on Chopin's own intense feeling of nationalism.

Now the great Paderewski, who was for a time President of Poland and could not sanely be accused of lack of patriotism, used to play Chopin in a style that has since greatly influenced many of his gifted followers—Pachmann, Cortot, Gieseking, Rubinstein and others too numerous to mention here. And none of them play—or played—the Scherzo like Woodward. (See the Orozco notice above.)

All this is intended to point out that in this, his latest Beethoven recital, he sometimes shows the same perversity. Thus he plays the first movement of the "Moonlight" Sonata with the pedal held down throughout the whole of the first movement, no matter what. harmonic changes take place. Moreover Woodward's tempo is absolutely metronomic, which added further to my discomfort.

I thought the rest of the sonata just plain dull, and this goes for the other two sonatas on the disc, too. A striving to find some novelty in the presentation of what might be described as standard works can sometimes—even frequently—lead to just plain eccentricity. One cannot change a language overnight. And strangely, on the record sleeve there is a photograph of Woodward playing the sonata, and the score in front of him is of an edition—I don't know which—plainly marked with the old, standard pedalling instructions.

Lighter Side

Reviews of other recordings

Devotional Records

DOUG LAWRENCE with the Ralph Carmichael Concert Orchestra. Stereo, Light LS-5671-LP. (From Sacred Productions Aust., 181 Clarence St, Sydney and other capitals.)

Doug Lawrence is a top-line professional baritone soloist who has appeared with leading American orchestras, including the Philadelphia Symphony under Eugene Ormandy, with numberous appearances at the Hollywood Bowl, the Los Angeles Music Centre and on the concert platforms of Europe. Yet he sees it as his duty to tithe his money and his talents, to which end he is baritone soloist at the Hollywood Presbyterian Church and is often found giving sacred recitals.

As you might expect from the above, his performance on this album conforms to the best concert standards, with sacred songs which, while not generally familiar to me, give scope for both voice and orchestra: Brother, Let Me Take Your Hand — While It Is Day — He's There Waiting — They Will Be Done — Back To Love — All Things Work Together — His Land — I Have A Friend Who Still Cares — No Greater Love — Pearl Of Great Price — His Wondrous Grace.

One point I should make: while Doug Lawrence has a powerful voice, backed by a powerful orchestra, he is equally capable of a gentle, intimate style, that emphasises the more personal aspects of his vocal message. The technical quality of the recording is excellent and, if you appreciate formal, concert style singing, you'll like this one by Doug Lawrence. (W.N.W.)

★ ★ ★

SUNDAY MORNING WITH CHARLIE PRIDE. Stereo, RCA APL1-1359.

Well known American country and western Charlie Pride should not need much in the way of introduction. Sufficient to recall that he has a smooth, pleasant, baritone voice and adequate diction but, of course, the inflections that characterise and distinguish C & W singers. And his selections also fit the C & W pattern: I Don't Deserve A Mansion — Be Grateful — He's The Man — In Jesus' Name I Pray — Without Mama Here — Little Delta Church — Next Year Finally Came — Jesus Is Your Saviour, Child — He Took My Place — Brush Arbor Meeting.

Recorded in RCA's Nashville Studios and backed by the well known groups "The Jordanaires" and "The Nashville Edition", there's a load of talent on the album and you should find it pleasant Gospel listening—provided you don't have a thing against the C & W style and inflection.

The actual sound quality is quite clean. (W.N.W.)

★ ★ ★

THROUGH A CHILD'S EYES. Annie Herring. Stereo, Sparrow SPR-1001. (From Spotlight Music Pty Ltd, 5th Floor, 264 Pitt St, Sydney 2000)

Based on the title and the cover picture of Annie Herring on a swing, one could be excused for expecting this album to be for—or about—children, but it doesn't seem to be. In fact, without meaningful jacket notes, without the lyrics, and without even clear diction on the part of Annie Herring, it is difficult to draw any obvious conclusion about the album.

Annie Herring is actually lead singer and songwriter for the very popular American Rock Gospel group "The Second Chapter of Acts". I gather that the musicians listed in the credits are also involved with the same group. It's probably because of this that the album is selling well and one can only conclude that its appeal is to fans of rock gospel in general and to fans of the aforementioned group in particular, title notwithstanding.

Here are the numbers: make of them what you can: Learn A Curtsey — Where Is Time — Wild Child — Death After Life — Grinding Stone — Hand On Me — Dance With You — Love Drops — Days Like These — First Love — Some Days — Liberty Bird — Fly Away Burden.

The sound quality is normal and okay if you want mainly to listen to the melodic structure. But, if you want to know what its all about, you'll have to work at it! (W.N.W.)

★ ★ ★

SOMETHING NEW AND FRESH. Noel Paul Stookey. Stereo, M7, MLF-133.

I have included this in the devotional section mainly because of current interest in the newfound spiritual experience of Paul Stookey, of the erstwhile trio: Peter, Paul and Mary.

While the title of the album is suggestive of change, the actual songs are noncommittal: moral, a little social comment, a little humour, touches of religious faith. They would appear to be intended primarily as musical interludes in a spoken testimony—in the style of the "old" Paul, but intended to blend with the "new".

The titles are: Remember/Pokey — Listen To The Love — There Was A Boy — You're The Only One — Underwater — Country Song — Et Misercordia — Numero 2 — Don't Use My Name — Please Porridge Peace — Take Me Out To The Ballgame — Aridd Le — Moremo Ontu Ne — Tom Quick.

Don't worry if the titles are new to you; an inner sleeve carries the words in full, so you can follow the performance and try out their possible context in an evangelical one-man appearance. The term "one man" might be misleading, of course, because a line-up musicians and vocalists have been used here, in the modern manner, to frame Paul Stookey's recital.

The quality is okay but, as I've said, don't expect an album of Sankey hymns. They're really the new Paul Stookey's mood songs. (W.N.W.)

Instrumental, Vocal and Humour

LA SCIE ENCHANTEE DE MAURICE DALLE. Stereo, Deesse DOUX-106. (From Sound & Film Enterprises of Aust. Pty Ltd, 122 Chapel St, St Kilda 3182.)

At various times I have seen would-be amateur musicians grip an ordinary carpenter's handsaw between their knees and, by tapping or bowing, coax something out of it that passed for a tune. In this album Maurice Dalle shows how well it can be done, especially when backed by a small but adequate instrumental group. A French recording, the track titles (and jacket notes) are mainly in that language:

Il Etait Une Fois Dans L'Ouest — Nabucco — Serenade — La Femme — Sadness Concerto — Chanson Pour Julianne — A L'Aube Du 5° Jour — Cap Sa Sal — Concerto Pour Un Ete — Foggy Day — Old Folk At Home — Classic A Celine.

Maurice Dalle wins from his saw a gentle, slightly quavering sound, not unlike a person whistling when in the higher register, or, lower down, the kind of tone one might win from a Theremin—complete with slight vagaries of pitch.

Reviews in this section are by Neville Williams (W.N.W.), Jamieson Rowe (J.R.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.), David Edwards (D.W.E.) and Greg Swain (G.S.).

LIGHTER SIDE

Unique, interesting, a conversation piece, I would nevertheless doubt whether you'd want to play it right through too many times, by reason of its melodic simplicity.

The limited dynamics of the performance make no demand on the recording and, not surprisingly, it is completely clean and free from either noise or stress. (W.N.W.)

★ ★ ★

THE WORLD OF OPERETTA FAVOURITES. DECCA SPA 466 Stereo.

This is another record from Decca's "World Of" series, featuring famous artists such as Joan Sutherland, Hilde Gueden, Pilar Lorengar — Regine Crespin — Renate Holm and Werner Krenn.

There are thirteen tracks covering most of the best known works on the operetta circuit, like; Die Fledermaus, The Gypsy Baron, The Merry Widow — The Chocolate Soldier — Orpheus In The Underworld — The Land Of Smiles — Nun's Chorus from Casanova. The recording dates range from 1958 to 1971 and the variations in quality are quite noticeable, as is the generally low recording level.

These comments aside, the record makes a good representative collection of these favourites. (N.J.M.)

★ ★ ★

LOS 3 SOLES DEL PARAGUAY. MARTER M 30-161 S Crest International release.

On this Spanish import album all the titles and information are in Spanish so I cannot tell you much, except that there are a dozen familiar sounding tracks played by three young men on strings, including harp. Their voices harmonise well and produce a very pleasant sound on a recording of excellent quality.

Some of the titles are: Rio Manso — El Condor Pasa — Bajando De La Sierra — Cancion De Las Americas — Sombras — Fina Estampa — Marta. If you are looking for a different treatment of Latin sounds give this record a hearing. Crest International are at 122 Chapel St, St Kilda, 3182. (N.J.M.)

★ ★ ★

HIT PARADE II. The Gene Harrison Chorus and Orchestra, with Seinen Starlets, the Branjo Hronez, Sound. Henry Arland. Dolby Stereo cassette, Contata A-111. (From Goldring Sales and Service.)

A happy continental sound, this one would make pleasant casual listening for the home, and even better for when you are bowling along the highway. Playing for something like 40 minutes, it offers 14 tracks, all vocal with orchestra: Chicken Train — All We Want On Earth — Who Is He — My Name Is Hase — Amarillo — Funny Funny — I Am — Only For You — One Girl Forever — Look What

They've Done To My Song — Hey Tonight — Dedicated — Pap Joe — Patta Patta.

Played back with the deck switched for Dolby, the balance is good and the sound clean, with stereo separation being particularly evident. Perhaps not pretentious musically but, as I said, happy! (W.N.W.)

★ ★ ★

PORGY AND BESS. MCA MAPS 1254 Astor release.

The sleeve of this record carries the somewhat ambiguous sub-title "Original Cast Album" on the front with the fine print on the back saying, "Featuring members of the Original New York Cast". So you can take your pick. Most of the best-known numbers are on the disc, such as: Summertime — My Man's Gone Now — I Got Plenty O'Nuttin — Bess, You Is My Woman — It Ain't Necessarily So — I Loves You, Porgy — There's A Boat Dat's Leavin' Soon For New York. The quality of the recording leaves a lot to be desired, with distortion on quite a few tracks, on the review copy, at least. (N.J.M.)

★ ★ ★

CATO BARBIERI, CALIENTE. A&M L36009 Festival release.

If you like your Jazz cool, with skilled instrumentalists and touches of latin, give this disc a hearing.

Gato Barbieri is probably best known for the score of 'Last Tango In Paris' and in this disc takes the lead with the tenor sax parts, other musicians being Lenny White, drums; Gary King, bass; Eric Gale, guitar; with David Spinoza and Joe Beck-Eddy Martinez, keyboards; Don Grolnick, Keyboards and synthesizer; Ralph MacDonald, Cachete Maldonado and Mtume on percussion.

The tracks are: Fireflies — Fiesta — Europa — Don't Cry Rochelle — Adios I — I Want You — Behind The Rain — Los Desperados — Adios II. The technical quality is really superb. (N.J.M.)

★ ★ ★

TALES OF MYSTERY AND IMAGINATION: EDGAR ALLAN POE. The Alan Parsons Project. 20th Century Records L35891. Festival Release.

Alan Parsons has impeccable credentials, he engineered Pink Floyd's "Dark Side Of The Moon", and was assistant engineer on the Beatles "Abbey Road". His more recent projects include albums by Steven Harley and Cockney Rebel, the Hollies and Ambrosia. This album is the result of a collaboration between Alan and Eric Woolfson. As you may have guessed, it is a concept album, the concept being that Poe's most famous stories were to be set to words and music.

The album was recorded and mixed at

Reader's Digest: "A musical feast"

GREAT MUSIC'S GREATEST HITS. 8-Record boxed set, Reader's Digest/RCA Dynagroove.

I have had this set for some time, without having reviewed it, because of an unfortunate oversight. However, it is still on sale by Reader's Digest and, I understand, selling very well.

This latter fact is not hard to understand, for it would have a very strong appeal to the many listeners whose main preference is for middle-of-the-road sound but who like to spice their musical fare with the more familiar classical excerpts.

And while these are excerpts, they are not just a motley collection of bon-bons. Each of the eight discs is devoted to a particular composer, with biographical notes on that composer, and notes on each of the excerpts or movements. It would take more space than I have available even to list every item, let alone give its full title, but here are some pointers:

RECORD 1—Beethoven: Symphony No. 5, 1st movement, "Moonlight" Sonata; Symphony No. 6, 1st movement; Symphony No. 9, "Ode To Joy".

RECORD 2—Tchaikovsky: "Nutcracker" Suite; Andante Cantabile; Serenade For Strings; "Marche Slave" Theme; Piano Concerto 1, &c.

RECORD 3—Johann Strauss: Blue Danube, Die Fledermaus, Vienna Woods and several others.

RECORD 4—Chopin: Etude in E; Polonaise in A-flat; Waltz in C-sharp minor; Fantaisie Impromptu, and others.

RECORD 5—Brahms: Symphony No. 3, 3rd movement; Hungarian Dance; Piano Concerto No. 2, and four others.

RECORD 6—Rachmaninoff: Concerto No. 2; Prelude in E-flat; Rhapsody on a Theme of Paganini; Vocalise.

RECORD 7—Mozart: "Marriage of Figaro" Overture; Eine Kleine Nachtmusik; Sonata in C; The Sleigh Ride, and more.

RECORD 8—Bach: Toccata and Fugue in D-minor; "Ave Maria"; Little Fugue; Air on a G-String; Sheep May Safely Graze, &c.

Such are the titles. Glancing down the orchestras and soloists one notices: Royal Philharmonic; pianist Earl Wild; New Symphony of London (Sir Adrian Boult); Vienna State Opera Orchestra; Hill Bowen & Orchestra; pianist Moura Lympany; pianist Abbey Simon; Oslo Philharmonic; London Symphony (Antal Dorati); RCA Victor Symphony; organist Virgil Fox; organist William Davies.

In one evening, I could do no more than sample tracks but quality and surfaces seemed well up to standard. In short, a real musical feast for the intended listening audience. (W.N.W.)

LIGHTER SIDE

Abbey Road Studios, with most of the musicians performing unaware of just what they were helping to produce. And what they did produce is a little hard to describe in a short review. As you would expect, there are liberal helpings of erie music, especially on tracks such as "The Tell-Tale Heart".

The second track, "The Raven", is particularly intriguing, as it makes use of a device called "The Harmony Vocoder". But the highlight of the album is "The Fall Of The House of Usher", a dark forboding instrumental exercise.

This album is obviously a must for all Poe fans, but would also complement any modern record collection. As one would expect with a record of this nature, recording quality is excellent. (D.W.E.)

★ ★ ★

SPECIAL EDITION, The Hawking Brothers Crest International CRINTV-119.

I must confess that I haven't heard of these artists before. The more the pity, as they do a fine job of harmonising on 20 country & western favourites; even the great Johnny Cash has praised them highly. A few of their titles are: A Good Love Is Like A Good Song — Me And Bobby McGee — Eighteen Yellow Roses Old Bark Hut — Wild Rover No More

— Catfish John — Last Train To Clarksville — Wild Colonial Boy — My Elusive Dream — Maggie May — Mama Tried.

The backing and overall quality is really excellent—an album to enjoy. Crest International are at 122 Chapel St., St Kilda, 3182. (N.J.M.)

★ ★ ★

AIRBORNE. The Flying Burrito Brothers. Stereo. CBS Records SBP234857.

The Flying Burrito Brothers are perhaps the best country rock band in the world, and listening to this record I can see (or should that be hear!) why. The songs on this album vary between straight country songs to straight rock numbers, with a fair number of other styles as well.

Tracks featured are: Waitin' For Love To Begin — Out Of Control — Big Bayou — Toe Tappin' Music — Linda Lu — Walk On The Water — Northbound Bus — Jesus Broke The Wild Horse — She's A Sailor — Quiet Man — Border Town. While all these tracks are of a high standard, I was particularly impressed with "Border Town" and "Big Bayou", although I must admit that Rod Stewart's cover version of this latter song appeals to me more.

Overall, I found "Airborne" to be a very impressive effort, both aurally and technically. There was almost no surface noise that I could detect, and the sound was quite clean, particularly at the high end. (D.W.E.)

★ ★ ★

TOM SULLIVAN. Stereo, ABC Records ABCD-967. RCA release.

Like many others, I was tremendously impressed by Tom Sullivan as a person, during his several appearances on Australian television; in particular by the way he was able to cope emotionally and physically with his blindness.

On this album, however, these qualities play little part. He is simply Tom Sullivan, popular vocalist, backed by chorus and orchestra, singing ten numbers: Fools Rush In — You're Gonna Find Love — Hold On To Your Lady — This Is Not My Town — Medley: Any Day Now, The Sun Ain't Gonna Shine — Provin' Time — Let Me Be Your Man — For The Love Of A Beautiful Woman — Yes I'm Ready — Lady For An Evening.

Tom Sullivan has a very light voice, ranging through to near falsetto, a style which does not appeal to me personally; you may react quite differently, particularly if you saw his TV appearances. Best you listen to a couple of tracks before you buy; it could please or disappoint according to your viewpoint.

The technical quality is quite okay. (W.N.W.)

★ ★ ★

COUNTRY GOLD. Conway Twitty, MCA Records MAPS 8360. Astor Release.

On this record, Conway sings twenty great country songs, mostly cover versions of other peoples hits, although there are a few of his own hits thrown in as well. There are plenty of fiddles, lots of wailing guitars and Conway's distinctive voice to guide you through such tracks as "It's Time To Pay The Fiddler" and "D-I-V-O-R-C-E", although since Billy Conolly, that last one will never be quite the same for me.

On the technical side, I was a little disappointed, as tape hiss was evident in quite a few places. (D.W.E.)

★ ★ ★

POP TIP TOP HIT TUNES. The Floyd Harris Orchestra with Chorus. Dolby stero cassette, Contata A123b. (From Goldring Sales & Service.)

From the title and the blonde teenager gracing the cover fold, I fully expected this to be teenage rock-style pop. In fact, it turned out to be a pure middle-of-the-road program that will please anyone who likes to be reminded now and again about yellow ribbons, and the 12th of Never.

The full title list runs like this: Power To All Our Friends — Come, Come — In The Eyes Of Others — Tie A Yellow Ribbon — Bianca — The 12th Of Never — Junger Tag — Signorina Concertina — Get Down — Hello, I'm Back Again — Killing Me Softly — I Am A Clown.

Played with the deck set for Dolby, balance, stereo separation and general quality were all okay. Surprisingly, a good one for those who like easy-on-the-ear M.O.R. sound. (W.N.W.)

DENISE, Denise Drysdale. Harliquin L25282. Festival release.

One of of the best known girls on local TV presents a dozen easy-to-listen-to ballads on this disc, recorded in Sydney and Melbourne. It is a pity that the backing group is not named as they do a fine job on the instrumental side on such titles as: A Love Song — Cows — If I Knew Enough To Come Out Of The Rain — Love May Be The Answer — The Loving Song — Green — I'm Just A Little Girl — Please Mr. Please — I'll Be Your Baby Tonight — Rescue Me — Come And Smile With Me — Rock Me Sweet.

If Denise is one of your favourite TV people, no doubt you will be off to buy this disc. (N.J.M.)

New Products

Drake SSR-1 communications receiver

The Drake SSR-1 is a high performance communications receiver covering from 0.5 to 30MHz, with a continuous dial resolution of 10kHz. It uses the well-established Wadley Loop system to provide very high front-end stability.

Not many years ago, you had to pay around $2000 to get a high performance triple-conversion general coverage communications receiver. And if you were lucky enough to be able to use one, you needed a couple of strong mates—or a sturdy trolley—to help you move it around. They were the size of a 43cm TV set, and a good deal heavier.

Well, the Drake SSR-1 costs around a sixth of the price of one of those monsters, and it is much smaller. It weighs only 6.4kg, and measures 330 × 280 × 140mm (W × D × H). You don't have to use it for very long, however, to realise that it is at least the equivalent of those earlier receivers in almost every way that matters. In fact it almost certainly excels them in terms of noise figure and stability, thanks to modern solid-state technology.

The SSR-1 is a true communications receiver, in other words. As such it is not to be compared with those "overgrown portables"—some of them selling for much higher prices—which tend to offer something like 600 square cm of "world range" tuning dial, but rather indifferent performance.

In comparison, the tuning window on the SSR-1 measures only 65 × 20mm. But in terms of the total effective length of the tuning scale—the parameter that really matters—it gives you just on 8 metres!

As you might expect, the SSR-1 uses triple conversion, with the established Wadley Loop system in the front end to cancel out drift.

The front end local oscillator tunes from 45.5MHz to 75.5MHz. This signal is mixed with the incoming RF signals after they have passed through an RF stage and low-pass filter, to convert them up into the first IF range 44.5-45.5MHz.

The local oscillator signal is also mixed separately with harmonics of 1MHz (derived from a 10MHz crystal oscillator), to produce a nominal second mixing frequency of 42.5MHz.

After passing through a bandpass first IF amplifier, the signals are fed to the second mixer where they are heterodyned with this second mixing frequency down into the range 2-3MHz.

As both the first and second mixing frequencies are derived from the same oscillator and the heterodyning is in opposite directions, any drift in the oscillator is cancelled out. The only effective drift of the front end is that of the 10MHz crystal oscillator, which is very low.

After amplification the signals are fed to the third mixer, where they are mixed with a second very stable tuneable oscillator covering the range 2.455-3.455MHz. This gives a final IF of 455kHz.

In effect, the front end of the receiver acts rather like a set of 30 crystal-locked converters, each shifting a 1MHz segment of the HF range down to the 2-3MHz segment for tuning by the rear end. The tuning control of the front end local oscillator becomes the "MHz" tuning dial, while the local oscillator associated with the third mixer becomes the "kHz" tuning dial.

The "kHz" dial of the SSR-1 is provided with 10kHz graduations, whose spacing varies between 2.5 and 3mm. This makes it quite easy to resolve within 5kHz.

In addition the SSR-1 is provided with a clarifier control, which varies the third mixing frequency in vernier fashion to facilitate tuning SSB signals. The range of this control is between ±2kHz and ±5kHz, varying a small amount over the 1MHz range of the "kHz" dial.

The SSR-1 is fitted with both AM and CW/SSB detectors. There are also dual bandpass filters in the 455kHz IF amplifier, which are switched along with the detectors. Selectively in the AM mode is 5.5kHz ±25%, and in the CW/SSB mode 3kHz ±25%.

Other features of the SSR-1 are the ability to operate from either the mains, internal batteries or an external 12V DC supply; provision for external speaker or phones; signal strength meter; inbuilt telescopic rod aerial, plus rear terminals for 75-ohm unbalanced aerial; a tape recording output; inbuilt 20dB aerial attenuator switch; and a rear jack for remote receiver muting.

Incidentally, we understand that the SSR-1 receiver sent for review is the first of a "third revision" of the original design, with improved performance over the previous versions.

Rated AM sensitivity of the SSR-1 is better than 3uV below 2MHz, and better than 1uV for 2-30MHz; the figures for SSB are 1uV below 2MHz, and 0.3uV for 2-30MHz. These are for 10dB (S + N)/N ratio, with the generator terminated in its source impedance. Rated calibration accuracy is within 5kHz at all frequencies.

Because of the up-conversion in the front end, the image conversion of this type of receiver tends to be very good: Drake rate the SSR-1 at better than 50dB. The IF rejection is also very good, being rated at better than 50dB below 20MHz and better than 40dB above 20MHz.

In checking the sample SSR-1 receiver, we could not check all of these figures due to test equipment limitations. But for those we could check, the SSR-1 was well within specs.

Drake don't actually give a figure for

CABLE RESISTANCE FAULT LOCATOR

The Dynatel model 710A cable resistance fault locator is designed to take the mystery and mathematics out of fault location in both aerial and underground cables. It is also suitable for use in mainframe cable troubleshooting.

No specialised training is required to operate the 710A, as the readout is directly in distance. Single step tests provide distance to strap, distance to fault, far end strap to fault and loop length measurements. All standard gauges of paper and PVC cables up to 200,000 ft can be tested with single fault detection of shorts, grounds and crosses up to 200 megohms.

Only two basic connections are required. A single hook-up of the pair in trouble is used for ground and battery cross analysis. A separate good pair hook-up is used for short and cross analysis. Null adjustments are made in one operation. Self testing and protection circuitry is built in, and the instrument is ruggedised for field use. One set of batteries provides up to 500 hours of operation.

Overall reading accuracy is ±0.5% ±1 digit, and automatic compensations for conductor temperature, pair twist and spiral loss are built in.

The Dynatel 710A is used widely by all major telephone companies in the USA and Canada.

Further inquiries to the Australian agents, Aegis Pty Ltd, P.O. Box 49, Thornbury, Victoria 3071.

C&K now agents for Lorlin switches

C & K Electronics (Aust) Pty Ltd has been appointed the Australian agent for Lorlin Switch Products, manufactured by the switch division of Lorlin Electronic Co Ltd, UK. This company is already well known for its range of special high-current on-off switches currently used in many colour television receivers on the Australian market.

Lorlin switches are heavily orientated to rotary-style types, including security Yale Key operated types.

Further information on Lorlin switches as well as on the full range of C & K's own products is available from C & K Electronics at P.O. Box 101, Merrylands, NSW, 2160, or from their interstate agents. Melbourne, tel. 88-5282; Adelaide 269-2544.

Drake SSR-1 . . .

tuning stability, but because of the importance of this we checked it out. The test we used was a stiff one, with the SSR-1 set for zero beat in SSB mode against a reference signal from VNG within seconds of switch-on from cold, and then its total drift measured over 30 minutes.

The maximum drift on this test was only 470Hz, reached after 15 minutes from switch-on. The SSR-1 then started to drift very slowly back towards its initial frequency, being only 350Hz away at the 30 minute check.

This is a very good result, bearing in mind that the above test is sensitive to BFO drift as well as that of the front end and third mixing oscillator. In short, the SSR-1 must be regarded as a very stable receiver.

Tested further in a typical home receiving situation, the SSR-1 gave very impressive results indeed. Dial calibrations and resolution were excellent, with known reference signals never more than a fraction of a millimetre from their nominal dial setting.

The clarifier control also proved very convenient when tuning SSB signals in crowded amateur bands, in conjunction with the narrower IF selectivity.

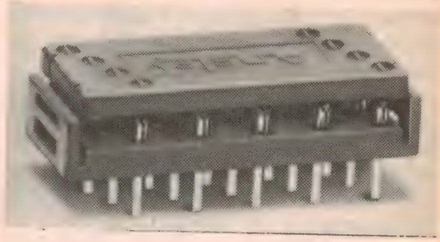
Very occasionally, adjustment of the "MHz" knob produced a small "birdie" when tuning for maximum signal. However these were always easily removed by slight re-adjustment, without significant reduction in signal level.

In short, the SSR-1 appears to be a very high performance communications receiver, and one which should appeal to anyone wishing to tune the full 0.5-30MHz HF spectrum with no compromises.

The sample receiver we tested was sent by Dick Smith Electronics Pty Ltd, who advise that they are selling the SSR-1 for $299.00. It comes complete with instruction manual and a bag of accessories. (J.R.)

NEW PRODUCTS

PC board connector for flat cable



A new range of flat cable piercing type connectors is now available from Ansley Electronics for terminating flat conductor cable to a PC board.

The new range incorporates Ansley's "tulip" contact design which ensures electrical contact reliability by providing a maximum of 4 contact points per conductor. A strain relief is built into each individual contact as well as the connector body to ensure dependable terminations.

The connectors are made of VE-0 glass filled nylon with hardened berylium contacts to ensure high conductivity and long life. The connectors have a temperature rating of 105°C, a current rating of 1A, and dielectric strength of 1500VDC.

Further information from Ansley Electronics, PO Box 91, Brookvale, NSW 2100.

Assembly manual for PM 40/40, Twin 25

Dick Smith Electronics Pty Ltd have submitted for review a sample of their assembly manual for the Playmaster Twin Twenty Five and Playmaster Forty Forty stereo amplifiers.

The new 20-page manual is well written, and replaces an earlier 16-page manual written exclusively for the Twin Twenty Five. It features detailed photographs and instructions for key steps in the assembly process, and even has hints on soldering and a pictorial component identification section. Pictorial diagrams of all the semiconductors are also included to help minimise confusion in insertion of these components.

Perhaps the most worthwhile feature of the manual, from the point of view of many would-be constructors, is the "sorry Dick, it doesn't work" return coupon. For a fee of $15 the PC board and the output transistors can be returned if the hobbyist is unable to obtain correct operation of the amplifier.

A copy of the manual is included with every Playmaster Twin Twenty Five and Playmaster Forty Forty kit purchased from Dick Smith Electronics.

New Scalar products

Scalar Distributors Pty Ltd has announced the release of several new products distributed by them. These include a "Hard Hat" mobile antenna; high power HF transformers; a marine vertical radiator antenna; a 1% automatic digital readout calorimeter; and mobile emergency flood-lighting masts.

Reader enquiries should be directed to Scalar Distributors Pty Ltd, 18 Shelley Avenue, Kilsyth, Vic 3137.

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Amateur radio

THE RADIO AMATEUR'S HANDBOOK, by the American Radio Relay League, Newington, Conn., USA 06111, 1977. Soft covers 165mm x 240mm, 664pp plus chapter on vacuum tubes and semiconductors, and index. Many diagrams, drawings, photographs and tables. Recommended Australian retail price $11.95.

What can one say about this Fifty-Fourth Edition of an annual publication which has not been said before? Difficult indeed. I shall therefore content myself with a short summary of the facts of this edition as I see them.

The objective of the publishers always seems to be to keep the publication as up to date as possible and as might be expected, emphasis is on new developments in solid state techniques. A perusal of this edition when compared directly with the edition for 1976 shows that of the 25 chapters, at least 13 of them have new material incorporated to a greater or lesser extent. Ten of the chapters have been kept substantially unchanged, while the chapter on Transmission Lines has been reduced in size to make space available for an increase in the chapter on Wave Propagation.

A colleague of mine commented to me many years ago that those of us who are interested in the field of electronics and more particularly in amateur radio, should buy a copy of the Radio Amateur's Handbook at about four yearly intervals. I am of the opinion that this comment is still even more valid today and if you are a beginner in the field, or if you have not bought a copy for a few years then the Fifty-Fourth Edition is a must.

The review copy came from Technical Book and Magazine Co. Pty Ltd, 289-299 Swanston Street, Melbourne. Copies should also be available from other technical booksellers. (I.L.P.)

College text

A FIRST COURSE IN APPLIED ELECTRONICS, by W. Gosling. Macmillan Press Ltd, London, 1975. Soft covers, 134 x 216 mm, 162pp. Many diagrams. Recommended retail price $8.95.

This is a revised and updated undergraduate "first course" in applied electronics. Rather than start in the conventional way with solid-state theory, it starts by assuming "black box" microcircuit amplifier and logic blocks with defined terminal behaviour.

It is therefore able to progress into the applications of the devices much sooner than otherwise, so that just about all of the book is devoted to the subject of interest—rather than just the second half. This should make it of particular interest to those doing a degree or diploma in a field other than electronics.

The chapter headings are: 1 — Introduction to Electronics; 2 — Fundamental Principles of Amplification; 3 — More about Amplifiers; 4 — Unwanted Outputs; 5 — Feedback; 6 — Feedback in Practice; 7 — Feedback Problems; 8 — Integrated Amplifiers; 9 — Some Practical Examples.

The text is clear and concise, and is well served by illustrations.

It would appear well suited for use as a text for introductory electronics courses, and also for private study.

The review copy came from the Australian office of the publisher, but the book should be in stock at all major and technical bookstores. (J.R.)

Microcomputers

AN INTRODUCTION TO MICROCOMPUTERS, Volume 1. Published by Adam Osborne and Associates, Berkeley, California, 1976. Soft covers, 134 x 205mm, many diagrams. Price $12.50.

AN INTRODUCTION TO MICROCOMPUTERS, Volume 2. Published by Adam Osborne and Associates, Berkeley, California, 1976. Soft covers, 134 x 205mm, many diagrams. Price $15.00.

8080 PROGRAMMING FOR LOGIC DESIGN, Published by Adam Osborne and Associates, Berkeley, California, 1976. Soft covers, 134 x 205mm, many diagrams.

Back in October last year we reviewed the second printing of the first edition of the Adam Osborne "Introduction to Microcomputers", and noted that it was shortly going to be released as two separate volumes. Not only has this happened, but the book has already begun to spawn further offspring!

What has apparently happened is that as planned, the "basic concepts" part of the first edition was expanded and split off to become the new Volume 1. That left the remainder of the first edition, the material dealing with specific microprocessor chips and their systems, to form Volume 2. But by the time the publishers came to produce the second volume,

two things became apparent. One was that there were a number of new devices, which should be included; the other thing was that each device really needed more detailed treatment than previously.

The most obvious result of this is that Volume 2 has now grown in size to more than double that of the complete first edition. Even so, the publishers explain that they have really only been able to provide what they regard as a sufficiently detailed and thorough coverage of four devices: the 8080A, the MC6800, the Z80 and the MCS6500.

In addition, because they feel that users need more help with the detail of programming and applying the various devices, the publishers have announced that they will be issuing a whole new series of books on specific device use. The first of these is already available, for the 8080; the second dealing with the 6800 is due to appear shortly.

Briefly, volume 1 is a basic introduction to microprocessors and microcomputers. It assumes very little background knowledge, apart from a basic understanding of electronics. It is concise and thorough, and if read carefully gives a sound grasp of virtually all the basic concepts of microcomputers.

Volume 2 then leads you into the real world of specific devices. There are 19 different devices or device families treated: the TMS1000, the F8, SC/MP, the 8080A, the Z80, the MC6800, the MCS6500, the PPS-8, the 2650, COSMAC, the EA9002, the IM6100, the SMS300, PACE, the CP1600, the TMS9900, the mN601 and 9440, the 2900 and 6700 series, and the MC10800 series.

Broadly speaking each device is first placed in general context, then its internal logic and addressing modes are described. Device pins and signals are described, together with interfacing and interrupt techniques. The instruction set is given, together with a benchmark program to illustrate various strengths and weaknesses.

In summary, the two volumes of "An Introduction to Microcomputers" are now even better than the first edition as an introduction to the subject and a reference. They would be almost essential reading for anyone planning to work with microprocessors and systems.

The first of the new programming books deals appropriately with the 8080. In brief, it is a detailed and down-to-earth guide for the logic designer, to help in making the change to microcomputer-based logic design.

Like the first two books it is concise, thorough, and well planned. As such it should be of great value to anyone seeking to become proficient in the design of 8080-based systems.

The review copies came from Dick Smith Electronics Pty Ltd, who advise that they currently have stocks of the first two, with catalog numbers B2340 and B2342 respectively. (J.R.)

Letters to the editor

Novices & CB

After reading the article on CB radio in the Yearbook and being a newcomer to CB there are several questions which spring to mind and I was wondering if you would be good enough to answer for me.

(1) I would be willing to obtain a Novice Licence, but does it permit me to use CB in my car?

(2) Where could I obtain the necessary theory required for such a licence?

(3) Is the Novice Licence good for all times or must I obtain a more advanced licence after two years, which is what the W.I.A. imply?

(4) Do you recommend any brands or types of sets, or where I can obtain technical information of various brands currently on the market?

The above questions may seem fundamental, but I find I am getting either vague or contradictory answers to some of them. If you could spare the time to answer them I shall be grateful.

Arthur P Hinvest
Lane Cove, NSW

COMMENT: To prepare for the Novice Licence, you could rely on private study or inquire from the WIA regarding courses. (See advertisements.) Officially, the 2-year tenure still applies but this could change; we hope it does! A Novice Licence holder can operate mobile and can use CB-type gear—but only talk to fellow amateurs within the amateur band, which excludes the use of CB channel 23. Also amateurs can strictly only discuss technical matters. Sorry, but we can't recommend particular brands.

Antisocial use of CB

I refer to the "Electronics Australia Year Book 1976/77", in which you present a case for CB Radio. As you are an advocate for the "yes" case, I think it fair to assume that you will minimise the points for the "no" case. I put here one of these points.

In "Modern Electronics" (August-Sept. '76) there is an article on CB's, apparently of American origin. The author states ". . . police are their favourite topic of conversation. Where they are, what they are driving, radar, speed traps, direction of travel, and what they are doing . . . Once the police are on the roads, the report goes out and the trucks settle down to the maximum speed limit. No one will exceed the speed limit if he knows a police car is half a mile ahead or behind him . . ." So what are these drivers doing when the report does not go out—driving irresponsibly and hoping to do so with impunity?

You present a "representative selection of some words and phrases of the jargon"—thirty definitions of which fourteen refer to police or police activities. The style of the jargon clearly indicates that the CB's do not see the police as the "good guys"—on the contrary, it indicates little respect for them as a law enforcement agency. How do you relate the "favourite topic of conversation" and the style of the jargon to your belief "that it will inevitably be abused by an irresponsible minority"? I put it to you that indications are that it will be abused by an irresponsible majority.

While it is a good thing that those in distress should receive early succour, and you list several examples of these, I would like to see published a list which can never be available—a list of the irresponsible motorists who have been sheltered from rightful apprehension by the use of CB Radio.

It is not enough to be a "good guy" some of the time; to be a hero at an accident, when it might well be that the driver responsible is one whom the CB warned down on a previous occasion.

Irresponsible motorists will only behave when they think surveillance is on. I can see no grounds for the belief that in sheltering them, the CB's are "helping the police"—all that they are rendering in this regard, is a disservice to the community.

C. Redman
Wallsend, NSW

COMMENT: What you really seem to be saying is that most people are antisocial, not just a minority. Perhaps you are right. But if this is sufficient reason to ban CB radio, why not ban cars as well? Apart from the practical problems in trying to ban either at this stage, the fact is that both facilities may be and are used for worthwhile purposes.

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

The Amateur Bands

by Pierce Healy, VK2APQ

What's in a name?

Give a dog a bad name and hang him—so says the old proverb. But the stigma of being judged guilty by inference is not appreciated by those qualified as amateur operators.

These notes for February, 1975, gave a short resume of the possible derivation of the word "Ham" as applied to amateur radio under the heading "Term of affection or disdain".

Over recent months the news media has been linking the term "Ham" with illegal (so-called CB) operations.

These comments are not intended to be an expression of opinion on potential citizen band operation, but an endeavour to correct that misnomer.

There is such a thing as poetic licence; but its use should not bring discredit or misrepresent.

It may be therefore, reasonable to suggest that there should be some set of standards whereby reports in the news media do not imply that any one person, group, or organisation is connected with the activities of another. Particularly when referring to controversial activities.

Assuming that it is due to being misinformed, let us look at these facts in the hope that those reporting such instances will be more enlightened on the subject.

For many years, even before the term radio communication was coined and it was wireless, not radio; the word "Ham" was used to describe a non-professional telegraphist or a person experimenting with wireless and using Morse code as a means of communication.

In general it referred to amateur experimenters in the field of radio communication and as that acitivity spread throughout the world it was a very simple and convenient expression understood by persons of all nationalities. In fact the word "Ham" came to mean—The Amateur Service—the official title recognised by the International Telecommunication Union; the specialised agency of the United Nations.

The amateur service is unique inasmuch as it is the only non-commercial communication service recognised and included in the ITU radio regulations. The ITU is the world administrative body which determines the regulations for all types of communication services, whether it be telephone, telegraph, cable, radio, broadcasting services, satellites, TV, etc., and determines the frequency allocations for such services. At present there are 152 member countries of the ITU.

Although the amateur service is controlled by each national administration, it has its own representation, a non-voting role, through the International Amateur Radio Union at major ITU conferences. The next is the World Administrative Radio Conference in 1979.

To review briefly, "Ham" implies

- a technically qualified licenced operator.
- an official communication service.
- represented by the IARU.
- the use of probable Morse code.

None of these points can be applied to the so-called "CB" activities.

Therefore, those who use the term "Ham" when reporting non-amateur radio activities or write headlines such as "CB Hams", are not only airing their own ignorance on the subject but are misleading the general public with grossly inaccurate statements.

Such mis-reporting has been a major cause of antagonism among some sections of licensed amateurs towards CB proponents.

Another cause for objection by amateurs is the illegal operation, within specified amateur frequency allocations, by persons with flagrant indifference to the amateur's code of ethics and to international or local radio regulations.

Point one of the amateur's code reads "... He never knowingly uses the air for his own amusement in such a way as to lesson the pleasure of others".

In addition amateur radio is a self policing activity. Amateurs, under the chairmanship of a departmental radio inspector, maintain an amateur advisory committee which reviews reported breaches of regulations or practices.

Failure by an amateur to correct breaches the committee brings to his attention may result in departmental action to restrict or cancel his licence.

CANBERRA EASTER CONVENTION

The ACT Division of the WIA invites amateurs, their families, and friends to attend the bienniel Canberra Easter Convention.

Here is a chance to renew old acquaintances, make new ones, have a pleasant weekend, have some old-fashioned radio fun and see the national capital all at once.

There will be ample time for sight seeing as the program is spread over Friday to Sunday night, with Monday free to have a final look at the capital and return home.

The date 8th April, 1977—11th Arpil, 1977.

The main venue is the East Basin Pavilion, which is off the Constitution Avenue, Russell. The secondary venue is the Griffin Centre, Bunda Street, Canberra City.

Registration fees will be $5.50 per amateur, $3.50 for ladies and 50c children.

The weather in Canberra during Easter is sometimes brisk but usually fine and sunny during the day.

The convention station VK1WI will be manned on 7050kHz SSB and channel 50 FM. The Canberra repeater VK1RAC, channel 6, will also be monitored.

There will be activities for children on both Saturday and Sunday.

Program: Day; Time and Events—

Friday 8th April: Mainly for travelling to Canberra, registration, setting up trade displays. The registration centre is the East Basin Pavilion.

Saturday 9th April:

0930-0950 Receiving contest, channels 40 & 50 FM also 3573kHz.

1000-1150 Hidden transmitter hunts, 2 metres AM and channel 50 FM.

1200-1300 Lunch—pies, sandwiches, coffee and tea at the Pavilion.

1300-1315 Surprise event at the Pavilion.

1330-1345 Ladies VHF scramble.

1400-1515 Two metre talk-in transmitter hunts.

1415-1715 Three hour coach tour of Canberra showing you the high and low spots of the national capital.

1530-1700 Two metre FM transmitter hunts.

1715-1725 Two metres SSB/AM scramble.

1745-1755 Novices vs the Rest—all band scramble.

1800-???? BBQ and social get-together at the Pavilion.

Sunday 10th April:

1000-1130 WAWC Mobile Contest; the only one of its kind in the world—no one else would dare! Every competitor gets a beautiful multicolour "Worked All Water Closets" certificate.

1145-1245 40 metre hidden transmitter hunts.

1315-1445 Lake cruise—the launch "Mimosa" will take you on a 1½ hour cruise on Lake Burley Griffen during which lunch will be served. Note:—the cost of the cruise ($6.50) is not included in the registration fee.

1500-1530 Pedestrian 2 metre AM transmitter hunt.

1545-1700 Two metre FM transmitter hunts.

1700-1830 Transfer to the Griffen Centre for evening's proceedings.

1830-1930 General interest films at the Griffen Centre.

1930-2030 Contest results and prize presentation.

2030-???? Social get-together and farewells.

A note of warning: Accommodation is critically short in Canberra over the Easter period. The Convention committee has arranged for accommodation at four locations in Canberra which should cater for most tastes. However early booking is absolutely essential. A deposit of $10.00 is required.

Address correspondence to—Canberra Easter Convention. PO Box E338, Canberra, ACT, 2600.

10GHz WORLD RECORD

A world record of 521km was made on the 14th August, 1976 by G4BRS and GM30XX operating from Cornwall and Scotland respectively. Both used low power Gunn oscillators running at 10mW. G3BRS used an 0.76 metre dish antenna and GM30XX an 0.6 metre dish. Signals were exchanged directly on 10GHz without the use of liaison on a lower frequency, and both stations were operated single-handed.

The tests were conducted over a three hour perioc and signal strength measured by G4BRS ranged from 10dB above the noise to 45dB above the noise.

THE NOVICE LICENCE SCENE

There has been much discussion and many reports on the standard of the Amateur Operators Novice Licence theory papers, in particular the paper for the November 1976 examination.

It is pleasing to note that the federal executive of the WIA is taking the matter up with the appropriate department.

In the January issue of the WIA official magazine, Amateur Radio, was the following statement from David Wardlaw, VK3ADW, federal president, WIA.

"It is now some time since the introduction of the novice grade licence.

"After many delays we have now reached the stage where two examinations have been held. It is therefore rather disappointing to note from the many reports received that the standard of these examinations appears to have been set at a level not much below that of the AOCP theory exam.

"If the concept of the Novice grade is to succeed, and we want it to succeed, the examination standard must be set at such a level to be achieveable by those for whom we believe the grade was intended and not just for near-miss AOCP candidates.

"The executive is pursuing this matter".

A ten day novice licence seminar was conducted from 29th November to 10th December, 1976 at the Box Hill Technical College especially for teachers of Electrical Practices courses in a number of schools in Victoria.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent to Pierce Healy at 69 Taylor Street, Bankstown 2200.

AMATEUR BANDS

Fourteen teachers attended the course and their backgrounds ranged from virtually no electronic knowledge to a few who had done industrial electronics at night school. Two had fairly advanced certificate level courses to their credit and really only participated to learn some of the specific amateur radio jargon.

At the commencement of the course the class was given an attempt at the trial novice exam set by the NSW division YRS. Nine members obtained less than 70%. The class average was 64%. At the end of the course the organisers sprang a surprise and gave the same exam paper. Only two members got less than 70% and the class average shot up to 80%. It was considered that even though the class had some familiarity with the paper, the second run was an indication that a better understanding of radio theory had been achieved.

A number of text books were used, but those most accepted were the ARRL—Course in Radio Fundamentals, and Keith Howard's, VK2AKX—Manual for Novices.

The teaching task was shared by seven staff members of the Box Hill Technical College Radio Department. Practical sessions using instruments and components were included when time permitted after the course. The college staff concluded that in many ways the course had covered more areas than the normal radio apprenticeship course. However, the depth with which the topics were covered was nowhere near as detailed as the apprentice course.

The aim of the course was to raise the standard of the participants to a higher level than the novice licence requirements, so that an expertise was developed to enable the teachers to pass on their knowledge in the schools when training more young operators from among their students.

It is possible that some of the class will attempt the limited licence exam and indications are that they should do well.

Morse code was taught for one to two hours per day. Copies of practice tapes were made available for home study.

This report, received from Graeme Scott, VK3ZR concluded with the following concept:—

"If we teach more people to train more amateur operators, then the strength of the ranks of competent operators will be increased".

A syllabus for the novice theory examination has been prepared by the recently formed WIA federal education committee and passed to the PMG's Department for consideration.

The November, 1976 novice examination results for the three sections were:—Morse code 55.7% pass; theory 48.9% pass; and regulations 69.4% pass. The lack of a syllabus and the standard of the theory paper is considered to be the reason for such a low percentage of successful candidates.

NOVICE MANUAL: the manual, written by Keith Howard, VK2AKX and published by the Westlakes Radio Club was the 1976 bestseller for aspiring amateurs in Australia. The 1977 edition has been updated and contains 106 pages of definitions, explanations, sample questions and answers.

Copies of the manual may be obtained for $2.60 post paid within Australia from the Westlakes Radio Club, PO Box 1, Teralba, NSW 2284.

PRACTICE NOVICE EXAM

The Victorian Division of the YRCS will hold a practice novice examination on Saturday, April 2, 1977.

The exam will be held at a venue near Melbourne city and will be similar to the official (Postal and Telecommunications Department) novice exam in all sections; theory, regulations, and telegraphy (sending and receiving). Any person in Victoria may attempt the practice exam. Results will be posted within two weeks of the exam. at the latest.

The YRCS practice novice exam will be held just over a month before the next official novice exam. If you are intending to get a novice licence, you should attempt the YRCS practice novice exam.

Persons wishing to attempt the practice exam should send a letter to:

The Examiner,
11 Vista Ave.,
Kew, Vic. 3101.

Enclosed in the letter should be: one self-addressed envelope; two loose 18c stamps, and a note containing full name, postal address and phone number. Applications should be postmarked by or before March 21.

Candidates will receive a letter before the examination, giving exact venue, time and other details.

YOUTH RADIO SCHEME

Subsequent to the YRS notes being prepared for the January, 1977 issue, the following points of interest on the activities of the Victorian YRCS came to hand from Kevin Baker, VK3BKR.

During the past year new instructional notes to cover the new syllabii were introduced. More than 80 certificates have been issued to successful students who used them as the basis for study. Sixty of the certificates were for the Elementary Stage 1 and the remainder for the Elementary Stage 2. At least two YRCS members gained their novice grade licence and it seems certain that there were others.

Thirty clubs registered with the YRCS in Victoria during 1976 and an invitation has been extended to any club in Victoria interested in joining the scheme to contact the state supervisor, Reverend Bro. Frank Whittom, VK3BAN, 204 Churchill Avenue, Braybrook, Vic. 3019.

Instructional notes for Elementary Stages 1 and 2 are available from the State supervisor at $1.00 and $1.50 respectively. The booklet written by Roy Hartkopf, VK3AOH, Logic and Logic Circuits, is also priced at $1.00.

It is planned to hold the annual general meeting of the YRCS, Victorian Division on Friday, 25th March, 1977, at 7.30pm at the Christian Brothers College, Queenberry Street, North Melbourne.

REPEATERS

During January, 1977 meetings were held in the Goulburn and Newcastle areas of NSW between members of the VK2 (NSW) divisional council WIA, the repeater committee, representatives of various radio clubs, zone officers and members.

The object of the meetings were to discuss many aspects relating to repeater channels and operation in VHF and UHF bands. Also many matters associated with divisional activities were dealt with.

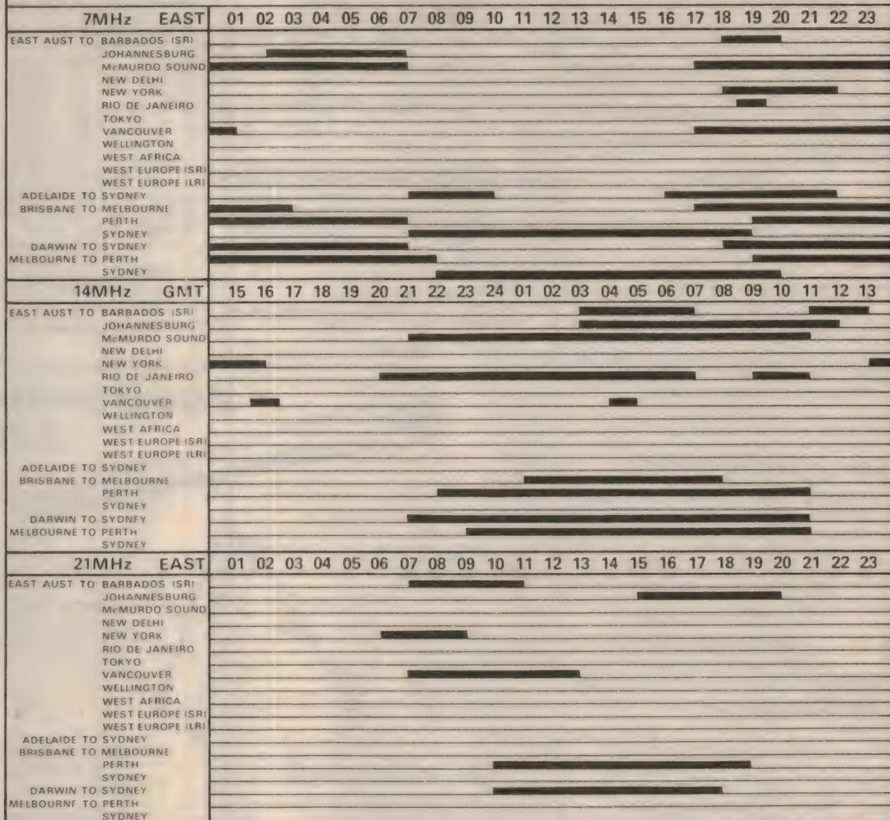
Similar meetings are planned for other areas in the state.

Details of repeater channels and allocations within Australia are available in "Electronics Australia Year Book for 1976/77", WIA magazine "Amateur Radio" (on circulation to members only); and a handy wallet leaflet prepared by the NSW division WIA and issued with the compliments of Jacoby Mitchell Co.

A note of interest on repeaters from overseas. The first repeater in France was put into operation during the latter part of 1976. It is located in the Pyrenees, near Foix and has an output of 10 watts on European channel R1; 145.025/145.625MHz. Unlike most of other European repeaters this unit is carrier activated, no tone signals are needed. Coverage is reported to be the whole of Southern France.

IONOSPHERIC PREDICTIONS FOR MARCH

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 3.77



CB Vs AMATEUR RADIO

In a note received from Graeme Scott, VK3ZR, WIA federal education officer, he posed this point for thought among those advocating CB type communication.

CB systems are intended to provide short-range person-to-person links, involving genuine personal or commercial messages. It is not intended for amateur type chatter and, in fact, some legislation specifically forbids amateur type operation.

Genuine amateur radio, on the other hand, opens up a whole new vista of activities. These include local and world wide communication on medium, high, very high and ultra high frequencies using speech, Morse code, slow scan television, amateur television, radio tele-type, repeaters, satellites, moonbounce and other types of transmission.

In addition there are local and worldwide contests to participate in and the opportunity to discuss the ideas and problems of a technical nature with persons with the same interests in other countries. Amateurs have been and are currently engaged in original research in the electronic field such as digital and data processing, microprocessors and the like.

Graeme suggests that an association with the amateur fraternity through the WIA or amateur radio club for twelve months would prove that there are much broader horizons in amateur operation than in CB operation.

Amateur radio is not a closed society as some would like us to believe. If it were, amateur societies would not be working to encourage more to take up the hobby. The WIA would not have its Youth Radio Club Scheme and other facilities such as lecture and correspondence courses for those who want to gain the knowledge required for an amateur licence.

RSGB COMMENT: Articles supporting the introduction of CB in England have appeared in various publications in that country. Commenting on that fact in the November, 1976 issue of the Radio Society of Great Britain magazine—Radio Communication—it stated; "It is apparent that much of this material has been generated by those who will profit financially from the introduction of the facility rather than by potential users".

It further stated that the RSGB is not opposed to the introduction of a short range personal communication facility provided that its location in the spectrum and the equipment used are suitable.

It went on to say that the 27MHz band as used in the USA and some European countries is probably one of the most unsuitable frequency bands that could be envisaged, for three main reasons:

a. its proximity to the amateur 28MHz band and the consequent availability of high power equipment together with the ease of illegal operation in this band.

b. the existence of long distance propagation during part of the sun spot cycle.

c. the interference to television receivers, particularly those operating in Band 1. Having regard to equipment now available it would appear that a VHF or UHF FM service with power limitation, crystal control and type approved apparatus could be suitable.

Further, if this facility is eventually allowed it ought to be located in a part of the spectrum remote from any amateur allocation to prevent illegal operation in an amateur band such as is now experienced in the USA.

RADIO CLUB NEWS

BLUE MOUNTAINS RADIO CLUB: Five members of the club, Peter Willis; Fred Santos; Terry Ryeland; Cec Healey; Steven Chivers were successful in the November, 1976 novice exam. Terry Ryeland also gained his limited licence.

The club has been allotted the call sign VK2NCM and members are constructing an 80 metre club transmitter. Practical work nights commenced on Monday, 7th February, 1977 at the Blaxland Primary School. An invitation is extended to those interested to attend these classes.

BC221 FREQUENCY METERS

Brand new in original packing cases—unopened complete with 240 volt power supply. Charts, etc. $90 each—cartage to rail $2. Freight payable at nearest attended Railway Station

P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$35.00

(2 TELEPHONE SETS)

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FOUR CHANNEL VHF TRANSCEIVER

125 to 140 M/hz. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator.

$33.00

TUNING UNITS

T.U. Series. Contains variable condenser suitable for aerial tuning, vernier 5" Ceramic Coil Former, etc. 19" rack mounting, only $9.50 ea. Post A. $2.30, B. $3.75, C. $4.80, D. $6.55

ILFORD 17.5 mm SPROCKETED MAGNETIC TAPE

1000 ft reels brand new original packing **$4.00 ea.** quantity available

Post A $1.30 B $2.00 C $2.30 D $2.80

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With headphones accessories etc

$60

TELEPHONE WIRE

1 mile twin (2 miles) genuine ex-Army Don 8 perfect condition $35 per drum $2.00 cartage to rail freight payable at destination.

PRISMATIC COMPASSES

Genuine ex-army Mk 3. liquid damped, as new $45.00 P & P A $1.70, B $2.25 C $2.40, D $2.65

MORSE KEY $1.75 Post 40c | **MORSE KEY BUZZERS** $4.25 Post 60c

DYNAMIC TRANSISTOR CHECKER

Provides a visual indication of signal output. Tests electrode open circuits, short circuits current gain $18.20 ea
P & P A $1.70, B $2.25, C $2.40, D $2.65

MULTIMETER

A compact and handy tester for workshop or lab where quick circuit checks are required

DC Volts 2.5 to 1,000V (20,000 OHMS per volt) AC Volts 10 to 1,000V (10,000 OHMS per volt) DC Current 50 UA 25 MA 250 MA Resistance 40 K OHM, 4 MEG OHM Decibels minus 20 DB plus 62 DB complete with instructions only $22.50 Ea. P.P. $1.05. Multimeter similar to above 30,000 OHMS per volt $29.50 P.P. $1.05.
Only $17.25 ea Post $1.05

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Type B3
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$1.50 each P & P 80c

5" CRO TUBE 5 BPI $5.50 each

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HANDY SIGNAL INJECTOR

Produces an Audio Signal in rich harmonics. Ideal for Sig Tracing in A.F., I.F., and R.F. circuits. Powered by 4 Penlight Batteries with On Off Switch and indicator lamp. Size 1½" Diam. 5" Long. Only
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522 Transceivers 100 150M CS
$35.00

POSTAGE KEY:

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B: Vic, Qld
C: SA, NT, Tas, New Guinea,
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		6GV8	$1.50
6SN7GT	95c	CV850	$1.50
5U4G	95c	1H6G	75c
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2 x 2	75c	VR65	75c

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ZOOM SPOTTING SCOPES

30 x 30
LENGTH 12½", HEIGHT 10"
WEIGHT 1¾ lb.
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LENGTH 16", HEIGHT 10"
WEIGHT 2 lb.
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High grade coated lenses. Ideal for pistol and rifle ranges or general viewing. Zooms in from very low to high powers. Complete with tripods.

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PRISMATIC Coated Lenses. Brand new. Complete with case.

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10 x 50	$41.00
12 x 50	$42.50
20 x 50	$47.50

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15X $5.20 Post 60c

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2-16 M/cs $65
Transmitter No. 11 suits 210 $35
24 volt Power supply to suit above $15.
Or complete station with Headphones, Mic, Morse Key, Antenna $110

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Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio, etc.
$2.50 P & P 20c
200 MA 24 volt, ⅛in push movement. $2.50 P & P 20c.

SELSYN MOTORS MAGSLIP

RECEIVERS 2" MK2 $5.50
TRANSMITTER 3" MK2 $15.00

Post Packing A. $1.75 B. $2.75 C. $2.75 D. $3.65

3000 TYPE RELAYS

P.M.G. 200Ohms — 1'500Ohm
Coils $2.50 each P & P 60c

P.M.G. TYPE KEY SWITCHES.

75c P & P 20c

Cossor Double Beam Oscilloscope 1035 Tested. $150.00

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25 x 30 $7.95
P & P A. $1.70, B. $2.25 C. $2.40 D. $2.65

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100 to 500 M/HZ
240 Volt operated
PERFECT CONDITION
$375.00

SPECIAL
NEW HAND DRILLS

German Ixion Double Pinion usually $13.25
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SMALL COMPUTER PANELS

3in x 2in containing 2 valves, qty of resistors, etc
ONLY 75c. P & P 60c

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Austronic type DFC 4 240V 50 cycle 0 100K Hz
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E M I type PRA-1 455 variable Kc
Course 440-520 Kc
Centre Freq 520-440 Kc
Fine Centre Freq 20-0-20
Filter band with 50, 100, 200 L F 200 H F Sweep band width 0-200

$75.00.

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Ex Army

No C42 set. 36 to 60 MHz complete with 24V power supply, headphone, mic, leads etc $65.00.

No C45 set. 23 to 38 MHz complete with mast, headphones, mic, 24V power supply etc $95.00.

$1.00 cartage to rail, freight payable at nearest railway station

Hartley double beam oscilloscope Type 13A with probes
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PRC9 AND 9A 27 to 39 M/HZ
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1 watt, 11 transistor $142 set of 2
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"KAISE"

SK-100 Multimeter 100,000 ohms per volt, 12 Amps. AC or DC $56.00
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70 OXFORD STREET, SYDNEY 2010

SORRY NO C.O.D.

Shortwave Scene

by Arthur Cushen, MBE

The International Committee of the Red Cross at Geneva has announced plans for further test transmissions during this year and have made a change in the program format.

The test transmissions from the Red Cross are to be broadcast every second month over a period of three days and will be transmitted on 7210kHz. The transmission times are 0600-0700, 1130-1230, 1700-1800 and 2200-2300GMT. The program has been altered and the transmission on Mondays is in English, Wednesday is in French and German, and Friday in Spanish and Arabic. The dates for the tests during the present year are:

March	21	23	25
May	23	25	27
July	25	27	29
September	26	28	30
November	21	23	25

Verifications are issued to overseas listeners for a correct reception report which should be addressed to the Radio Division, International Committee of the Red Cross., Ch 1, 211, Geneva, Switzerland.

FEBA SEYCHELLES

The Far East Broadcasting Association in the Seychelles has been heard on several new frequencies with its gospel programs. Signals on 9510kHz have been received at poor strength from 1800GMT with programs in Arabic and English, according to Bill Huddleston of Auckland, reporting in the New Zealand DX Times. From the same publication John Mainland of Wellington reports reception on 9725kHz, opening with an interval signal at 0310GMT, with a program in Swahili. However, this channel suffers interference from the Swiss Broadcasting Corporation. The station has also been heard on 15280kHz from 0600-0800GMT with an English program to Asia, but reception is spoilt at times with side-band interference from the Voice of Malaysia on 15275kHz.

TWR GUAM

The new Trans World Radio transmitter of 100kW to broadcast from Agana, Guam, has been issuing a tentative schedule for broadcasts to South East Asia and the Far East. According to Dene Lynneberg, reporting in the Down Under DX Survey, the frequency of 11705kHz is to be used 0900-1400GMT, but it has been suggested that 11850kHz would give better coverage for the period 1400-1500GMT. Already a medium-wave transmitter KTWG is in operation on 770kHz using the power of 10kW. Two shortwave transmitters are under construction and should be broadcasting by the time this item is published.

NEW CUBAN FREQUENCIES

Radio Havana Cuba has been heard on two new frequencies with its transmission in English from 0400GMT. Signals have been noted on 9685 and 11795kHz, but 11760kHz still provides the strongest signal. This transmission is beamed to North, Central and South America as well as the Caribbean area and the station is asking for reports to P.O. Box 7026, Havana Cuba.

Havana is also being heard on a new frequency of 9715kHz at 0800GMT, when the signal is mixed with Radio Nederland, Bonaire which is broadcasting in English to Australia and New Zealand. The broadcasts at this time from Havana are in Spanish.

NEW VATICAN AERIAL

Last month we gave details of the new rotatable aerial operated by the Swiss Broadcasting Corporation which was claimed to be the highest in the world. This has now been outdone by a new aerial brought into operation by the Vatican radio, which has a rotatable aerial 79 metres high. The Swiss aerial of similar construction is 56 metres high. Both systems rotate on a circular rail so that they can be beamed to any part of the world. The new Vatican radio aerial has been coupled to a new 500kW transmitter. This complements the present five 100kW transmitters, which have been in operation for several years. The Vatican continues to broadcast to Australia and New Zealand in English 2210-2225GMT on 7235, 9615 and 11705kHz.

FM RECEPTION

The first reported reception of Australian FM signals in New Zealand, in a recent issue of the New Zealand DX Times, indicates that Brian Oliver of Kerikeri in Northland heard the ABC FM transmitter in Sydney on 92.9MHz. It was heard around 0630GMT. Later in November Bryan Clark in Wellington heard the Melbourne station 3MBS-FM on 92.5MHz. It was copied for a period around 0230GMT, although no actual station announcement was heard. During December Brian Oliver heard two other ABC stations and the Sydney private station on FM.

During this period of the year, up to March, Australian television reception is almost commonplace in New Zealand and many viewers are troubled by Australian television interference during the summer months. The first reception of Australian television in New Zealand was in 1956, when Maurice Wills of Invercargill saw the early Melbourne telecasts.

1977 CONVENTION

The 1977 Convention of the New Zealand Radio DX League will be hosted by the Canterbury Branch in Christchurch over the Easter period April 8 to Monday April 11. Considerable listening will be done at a camp near Christchurch, coupled with social activities and a visit to Radio Avon. This seems to be destined to be the biggest convention yet, as far as overseas members go, with visitors from Canada, United States, Hawaii and Australia. Readers requiring information concerning the convention should write to Convention '77, New Zealand Radio Dx League, P.O. Box 18560, Christchurch.

MEDIUM WAVE NEWS

NEW ZEALAND: Station 2ZK Hastings, is the latest station to be operated by Radio New Zealand. 2ZK operates on 730kHz with 2500W and in June this will be increased to 5kW. The new station will carry Community and Concert programs and operate 1800-1215GMT. "Apple Radio" is the slogan of the new broadcaster, which is located in Hawkes Bay the apple centre of the country. The transmitter is housed with 2YZ Napier, and uses a 44m mast.

EUROPE: Shortwave listeners are familiar with the power race by international stations but, on medium wave, higher powered transmitters are also being installed by many countries. In the past month in Europe three of these transmitters went into operation. BBC Monitoring Service report that Radio Prague, Czechoslovakia has increased power to 1500kW on 638kHz, Radio Budapest in Hungary is now operating 2000kW on 539kHz, while Radio Belgrade, Yugoslavia, which has been running 1000kW on 683kHz, now uses 2000kW. Equipped with a special aerial system, it is expected that the total effective radiated power will be 3000kW, thus making it the most powerful broadcasting transmitter in the world.

VIETNAM: A new powerful transmitter has been heard broadcasting from Vietnam and, according to Radio Hanoi, this is the old Voice of America transmitter which was located at Hue. The Voice of America operated a 50kW transmitter on 760kHz which went off the air in early 1975. At first it was thought that the transmitter had been airlifted out of the country, but Radio Hanoi now claims that the station has been reactivated, thus making it the most powerful transmitter in the country. According to the BBC Monitoring Service, nine new transmitters have been installed, and three south-facing antennas, increasing its transmitting capacity by 45 percent. The five year plan calls for the development of broadcasting and wired radio programming, which would cover 250 communities in key agricultural regions by 1980.

LISTENING BRIEFS
EUROPE

SWEDEN: Radio Sweden has made a further frequency change for its transmission to the Far East, which includes a broadcast in English 1400-1430GMT. The new frequency is 9545kHz which replaces 9765 which in turn replaced 9750kHz. Two other frequencies carry the same transmission: 11925 and 15305kHz.

FINLAND: Radio Finland has made some frequency changes this month and has retimed one of its transmissions. The new 250kW transmitter is now in regular operation and is used in all transmissions. The English broadcasts 0930-1000GMT are on 9550, 11755 and 15270kHz, 1330-1400GMT on 15260 and 15110kHz, 1430-1500GMT on 6120, 11755 and 15110kHz, 1900-1930GMT on 15265 and 11755kHz, 2000-2030GMT on 11755 and 9550kHz, 2330-2400GMT on 11755kHz.

AFRICA

ETHIOPIA: Radio ETLF the Voice of the Gospel has been heard on 15365kHz to closing at 1958GMT. The transmission was in French and fair reception has been possible from 1930GMT.

EGYPT: Radio Cairo's 0200-0330 program in English on 9475kHz to North America is now followed by a one hour broadcast in Arabic on the same channel and to the same target area. A news bulletin is given at 0345, according to the BBC Monitoring Service.

NIGERIA: The new frequency of 4900kHz has been widely reported in the transmission 0430-2305GMT. Dene Lynneberg reports reception at 1800GMT with time checks, while Peter Bunn in Melbourne reports good reception at 1900GMT. It is understood this transmitter replaces the old outlet of 4990kHz.

MAURITANIA: According to a schedule received by Peter Bunn in Melbourne Nouakchott indicates the Mauritanian Radio is on air between 0600 and 0900GMT, and from 1800-2400GMT on 4845kHz; the station may also be heard between 1200 and 1600GMT on 7245kHz. This means that Nouakchott is making greater use of the 4845kHz outlet, while cutting broadcast hours of the 7245kHz channel.

ETHIOPIA: Radio Voice of the Gospel at Addis Ababa has been heard by John Mainland of Wellington N.Z. beginning an English program beamed for reception in West Africa at 0525GMT on the new frequency of 11770kHz; it replaces the former channel, 11800kHz.

RWANDA: Adventist World Radio is planning test transmissions from the Deutsche Welle relay station in Kigali, according to Adrian Peterson of Poona, India, reporting to DX-ERS CALLING. If the test transmissions eventuate they will be broadcast before May of this year.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

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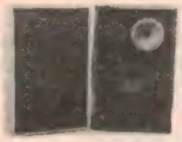
Fully constructed, ready to operate **$69.95**

Complete kit of top quality parts and instructions for the models 11 or 111 **$49.95** P.P. NSW **$3.50**, interstate **$5.50**.

30 WATTS OF EXCELLENT HI-FI WITH PLAYMASTER LOUDSPEAKER SYSTEMS



3-45L. Features the mighty 8-30 woofer. 6J midrange and the incomparable Philips AD016/T8 tweeter. this top quality low cost 3 way hi fi system is available from stock in either walnut or teak veneer and complies with the specs., as per April '75.

$84.00 each

3-41L. As described in June '76 E.A. Again features the mighty 8-30 woofer, with the advantage of the new Magnavox 6-25 midrange, and the more elaborate cross-over network. The dome tweeter is Philips AD0160/T8. Beautiful teak, or the ever popular walnut veneer cabinets are available. Either system can be carefully packed and despatched per airfreight passenger rail or road. Packed weight approx. 40kl. pair.

$96.00 each

HI FI CABINET KITS

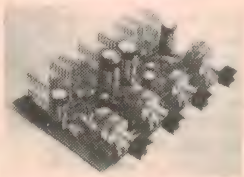
Do it yourself—big savings. Our kits are extra easy to finish. Top, bottom, each side and back are factory assembled, baffle is pre-cut. Veneered pyneboard. Teak or walnut. Complete with innerbond and speaker grille cloth. 8-30 3-45L. systems. **$55.00** pair.
MV-50 system **$69.95** pair.

FAMOUS MAGNAVOX AUST. MADE LOUDSPEAKERS

MODEL.	Imp	Watts. Rms	Reson. Hz	Freq.Hz	V.C.Dia.	Price	P.P
10-40 10"	8	40	45	30-8000	1½"	$23.00	$2.50
8-30 8"	8	30	45	30-8000	1½"	$19.00	2.25
12WR 12"	8	16	45	30-16000	1'	$16.50	2.00
10WR 10"	8	16	45	30-16000	1"	$13.90	2.00
8WR 8"	8	16	45	30-16000	1"	$11.80	2.00
6WR 6½	8	12	45	30-16000	1"	$10.90	22.00
6.J 6½	15	8	85	80-7000	1"	$8.50	1.50
6-25 6½	8	25	45	45-6000	1½"	$16.50	2.00
XJ3 Dome	8/15	25	1500	2000-20000	1	$8.95	1.30

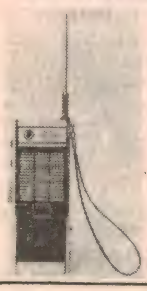
20WATT STEREO AMPLIFIER CHASSIS.

Update your stereo system with a hi-fi 10 watt RMS per channel amplifier. Small and compact. 85 x 145 x 45 mm h. Fully assembled—ready to operate. Easy to install in radiogram cabinet, recordplayer base, etc. 240V 50Hz power transformer included. Circuit supplied individual heatsinks for power transistors.



SPECIFICATIONS. Power Output 10 + 10 WRMS, at 8 ohms. Output Imp 8-16 ohms. Distortion. Better than 0.5% Freq. Response. 35-18000Hz. Sig. To noise. Better than 50dB. CH. separation. Better than 50dB. Input sensitivity. 500mV. Bass control +—10dB at 40Hz. Treble control +—10dB at 12000Hz. Power supply 28-0-28V. 1amp. Dim. 185 x 145 x 60M/M. **$33.95** P&P $3.50.

C-B 27MHZ COMMUNICATION EQUIPMENT



GEAR TO SUIT BUSHWALKER, FISHERMAN, CAR, TRUCK, BOAT OWNER

Model NC-310. Features 3 channels. Battery checker, squelch control, tone call switch, external aerial, speaker and power jacks, battery charger jack, spec. 13 transistors, RF input power, 1 watt. TX freq. Tol ± 0.005%. Tone call freq. 2000 HZ, RX. Sen 0.7UV at 10dB SN, sel 45dB at ± 10KHZ. If freq. 455 KWZ

$59.95 complete with book and circuit, p.p. $1.60 interstate $2.95.

Model Z Mobile. 6 channel 5 watts. 14 transistors. 8 diodes, squelch control, sig. strength/RF meter, microphone, book and circuit, 12 volt operation. Size 4¾" WX 1½" HX 6-⅜" d. **$118.00** p.p. $2.50 interstate $3.50.

WESTON 5 WATT C-B TRANSCEIVER

Great boat or mobile rig. Auto noise limiter, squelch, A.G.C. over-mod. limiter. Low pass filter for bandwidth. SPECS. T-mitter. Crystal locked, 5 watts input to RF stage. Freq. coverage. Any 11 channels., in 27 MHz band. Receiver, crystal locked, double superhet. 6.5 MC and 455 Kc 1fs 3" speaker, dynamic mic. 50 ohm antenna 20 t'sistors, 8 diodes, 12VDC operation. Sensitivity. O. 5UV 10dB S/N. Size 6½" x 2½" x 7¾". Wt. 4½ lbs.

PRICE $159.95 p.p. N.S.W. $4.50, Interstate $5.50

GARRARD MODEL 82

$57.00.

A superb 3 speed transcription changer/player. Auto/manual operation 4 pole magnetically shielded syn. motor Resiliently mounted Counterbalanced Elegant tone arm with slide-in cartridge carrier calibrated Antiskate, 265mm (10½"). Aluminium platter Cue and pause control Cartridge tilting lever. Magnetic cartridge diamond stylus. Size 375 x 335 x 170mm (14¾" x 13¼" x 6¼") 4.5kg (10 lbs) P & P $2.50 Interstate $3.50

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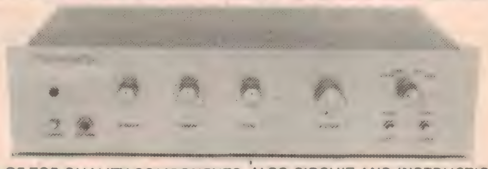
MODEL—6400 3 speed auto manual changer—player 2 spindles. Motor 2 pole 240V 50Hz 10½" turntable cue and pause, tubular section pick up arm, Sonatone cartridge, Great value 28.50.

PAYMASTER FORTY/FORTY STEREO AMPLIFIER



KIT OF TOP QUALITY COMPONENTS ALSO CIRCUIT AND INSTRUCTIONS.

$95.95. P.P. $3.50. Interstate $5.50. The 40/40 Kit is available with an assembled and tested printed circuit board at **$107.95**

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Complete kit of top quality parts with instructions **$77.50**
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Type A. $2.50EA. 4 for **$9.00**
Type C. $4.10EA. 4 for **$14.75**
Type D. $5.00EA. 4 for **$18.00**
P&P. $1.00 I State $1.75.
SANYO NICAD BATTERY CHARGER. **$25.95.** P&P $1.60

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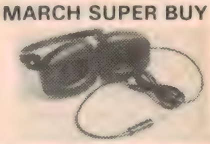

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INFORMATION CENTRE

TOUCH CONTROL: I am writing to enquire about the "Touch Control Table Lamp" in your March 1976 edition. I have made the unit out of all new parts and I keep burning out T2, T3, T4 and T5. I have stripped the PC board down and assembled it twice after testing every component for shorts and open-circuits and have found nothing wrong, except it keeps burning out these transistors.

Could you please tell me what is wrong?

How critical is the secondary of the transformer? (W.P., Newcastle, NSW.)

• Unfortunately, you have not described how the unit failed: whether the lamp was alight or extinguished or whether you ever succeeded in making the unit operational.

Possible causes for the breakdowns, other than faulty installation, are high voltage from the transformer secondary, intermittent breakdown from primary to secondary or high voltage spikes generated by the relay which may be abetted by an open circuit shunt diode.

The transformer secondary voltage should not be appreciably above that specified, but the current rating should be sufficient to provide that required by the relay and associated circuit.

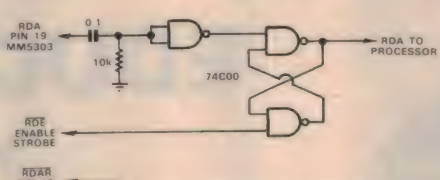
HOT TRANSISTORS: You could have warned us somewhere in the articles on the Playmaster Twin 25 that the BC639/640 pair would run pretty hot. I got quite a fright when I felt how warm they get since I'm not accustomed to transistors running that hot—unless they are "heatsunk". However, I calculate that with a 39 ohm emitter resistor setting the collector current at about 16mA the transistors are dissipating about 0.45W continuously. It's not surprising then, that a 0.8 to 1W rated transistor gets pretty hot. Shouldn't these transistors be supplied with heatsinks as there doesn't appear to be much copper associated with the collector leads on the PC board?

Anyway, a warning would not have gone amiss. (P.R., Palmerston North, NZ.)

• You are right. We could have warned readers that these transistors normally run warm. We apologise. Flag heatsinks can be fitted if you are worried, but they are running within ratings.

ASCII-BAUDOT TRANSLATOR: As you are no doubt aware, the National Semiconductor MM5303 UART device although pin compatible with the UART device specified for this project, is not directly suitable for it. This is because of the critical timing requirement for the RDA (reset data available) input.

As this device is more easily available than some of the other types, I thought you and some of your readers may be interested in the details of a simple modification to allow the MM5303 to be used.



RDA FLAG CIRCUIT FOR MM5303 UART

All that is required is a 74C00 device, wired as shown in the small diagram.

I hope this information is of interest

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

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ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

and assistance. (T. L. Gillett, Telecom Australia, Brisbane Qld.)

• Many thanks, Mr Gillett. The information should be of interest not only to those building the translator, but to anyone building circuits using UART devices.

NOTES & ERRATA

ASCII-BAUDOT TRANSLATOR (October 1976, File No. 2/CC/15): It was not stated explicitly that the translator was designed to operate at 50 bauds. This is in fact so, and the teleprinter must accordingly be set at this rate for correct operation.

27MHz Aerial—from p41

have to place an order and wait.

The first is a low pass filter, designed to be inserted directly into a 52-ohm antenna line. Such filters are designed to pass frequencies below 30MHz, hopefully with less than 1dB of loss, but to introduce attenuation of between 30 and 50dB at television and FM broadcast frequencies. While a low-pass filter cannot prevent direct front-end overload of a TV set, or direct 27MHz penetration into the IF channel, it should materially reduce any harmonic or stray radiation from the antenna above 30-40MHz.

The low pass filter pictured is advertised by Tandy Electronics for around \$10—but are literally as scarce as hens teeth! Dick Smith Electronics list a couple of filters (also in short supply)—one around the \$10 mark and another more elaborate type for about twice that figure.

In some cases, the action of a low-pass filter at the transmitter can be reinforced by a high-pass filter at the TV receiver terminals, designed to admit the television frequencies but to discriminate against a 27MHz carrier.

The one pictured, and the only one we have come across to date, is designed for 300-ohm ribbon and would therefore not be suitable for modern colour installations using 70-ohm coaxial downlead. However, it is worth knowing about, if only because most "portable" TV aerials still end up with a 300-ohm ribbon connection, even if it is only a few inches between the back cover of the set and the chassis. If the worst comes to the worst, a filter can be installed at this point without too much trauma.

Ocean Radar—from p23

tization can be effected with a PDP-8S minicomputer system. A sample interval of 0.1s is used, and blocks of 100s length are thus converted to give time series of 1000 data points each.

Spectral analysis is carried out on a larger PDP-10 system using, at present, a simple periodogram technique to compute the power of the first 100 Fourier components, with a spectral resolution of 0.01Hz in the range 0 = 1Hz. Aliasing is avoided through the use of the low pass filter mentioned above. Smoothing is effected with a hanning window, and the spectral ordinates are finally normalized to the maximum value before output. Incoherent averaging is performed simply by averaging the unsmoothed spectral ordinates of spectra recorded in the same time block and representing the same radar range and bearing, with the smoothing and normalization then applied as before.

The theory of the scattering of electromagnetic waves of various frequencies from rough water surfaces is now relatively well known. In particular, explicit formulations for the scattering cross section, to both first and second order, have been derived in terms of various assumed water wave spectra.

For the time being, however, the major limiting factor in the application of Doppler radar to remote sensing of sea states is the presence of ionospheric noise in the Doppler spectra. Nevertheless, the potential of both the general approach and the particular experimental facility of the James Cook University is very good, judging by the results obtained so far.

Reprinted in abbreviated form from the "Australian Journal of Physics", 1976, 29, 183-94.

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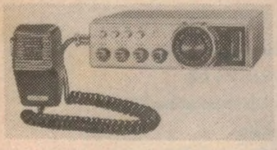

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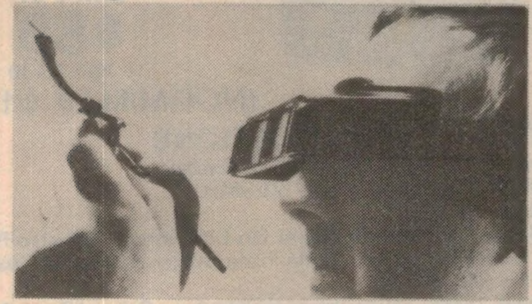

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